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# HANFORD LABORATORIES OPERATION MONTHLY ACTIVITIES REPORT AUGUST, 1958



Compiled by
Operation Managers

September 15, 1958

HANFORD ATOMIC PRODUCTS OPERATION
RICHLAND, WASHINGTON

[redacted]



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PRELIMINARY REPORT

This report was prepared only for use within General Electric Company in the course of work under Atomic Energy Commission Contract W-31-109-Eng-52. Any views of opinions expressed in the report are those of the authors only.

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| Manager, Biology | H. A. Kornberg |
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| Manager, Reactor and Fuels Research and Development | F. W. Albaugh |
| Manager, Employee Relations | T. G. Marshall |
| Manager, Financial | W. Sale |

TABLE I. HLO FORCE REPORT AND PERSONNEL STATUS CHANGES

DATE August 31, 1958

FORCE REPORT

| | At close of month | | | At beginning of month | | | Additions | | Separations | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Exempt | Non-Exempt | Total | Exempt | Non-Exempt | Total | Exempt | Non-Exempt | Exempt | Non-Exempt |
| Chemical Research & Dev. | 125 | 95 | 220 | 128 | 95 | 223 | 2 | 1 | 5 | 1 |
| Reactor & Fuels | 158 | 112 | 270 | 157 | 108 | 265 | 2 | 5 | 1 | 1 |
| Physics & Instrument | 65 | 25 | 90 | 65 | 25 | 90 | 2 | 1 | 2 | 1 |
| Biology | 36 | 41 | 77 | 36 | 42 | 78 | 0 | 0 | 0 | 1 |
| Operation Res. & Syn. | 14 | 3 | 17 | 14 | 2 | 16 | 0 | 1 | 0 | 0 |
| Radiation Protection | 37 | 114 | 151 | 39 | 116 | 155 | 1 | 1 | 3 | 3 |
| Laboratory Auxiliaries | 44 | 181 | 225 | 44 | 180 | 224 | 0 | 4 | 0 | 3 |
| Financial | 16 | 33 | 49 | 16 | 33 | 49 | 0 | 0 | 0 | 0 |
| Employee Relation | 73 | 38 | 111 | 81 | 34 | 115 | 2 | 6 | 10 | 2 |
| Programming | 15 | 4 | 19 | 15 | 4 | 19 | 0 | 0 | 0 | 0 |
| General | 1 | 2 | 3 | 1 | 2 | 3 | 0 | 0 | 0 | 0 |
| TOTALS | 584 | 648 | 1232 | 596 | 641 | 1237 | 9 | 19 | 21 | 12 |
| TOTALS EXCLUDING | 584 | 648 | 1232 | 596 | 641 | 1237 | 5 | 15 | 19 | 8 |

Composite Separation Rate 2.6785

Separation Rate (based on Separations leaving G. E.) 2.1915

Controllable Separation Rate .001623

## SUMMARY

### BUDGETS AND COSTS

Costs for August were $1,456,000 an increase of $100,000 over the month of July. Costs for FY 1959 to date represent approximately 14% of the annual budget which indicates a slight underrun at this time.

There are no unsatisfactory cost-budget relationships at this stage of the fiscal year.

### RESEARCH AND DEVELOPMENT

1. Reactor and Fuels

Measurement of stainless steel clad metallic uranium rod cluster fuel elements after KER irradiations of 600 to 2250 MWD/T duration showed little or no swelling. These test results would not be expected for unrestrained uranium according to British data.

Preliminary work on direct casting of uranium into Zircaloy cans has produced a strong and durable bond derived from a very narrow alloy zone.

Yield strengths of irradiated Zircaloy-2 and -3 were observed to be sensitive to strain rate, a ten-fold increase in strain rate raising the yield strength 8-9%.

Small voids have been observed on replicas of fracture surfaces of uranium with a previous irradiation exposure of only 0.026 a/o burnup.

A new laboratory jet impingement test has demonstrated that aluminum alloy X-8001 (formerly called M-388) is more susceptible to erosion-corrosion than standard Hanford can alloy 1245. This confirms the same difference between the two alloys noted in-reactor.

The most recent experiment in KER Loop No. 4 has confirmed previous observations that phosphoric acid at pH of 4.5 will decrease corrosion rates of aluminum in deionized water by factors of 10 to 50 - due to the combined effects of lower pH plus phosphate inhibition.

Representative graphite samples from DR Reactor exhibited stored energy values of 20 to 55 cal/gm, too low to cause a spontaneous temperature rise in the graphite.

A four-rod cluster of Zircaloy-3 clad Pu-Al fuel rods has been charged into a KER Loop and is operating satisfactorily.

The density of vacuum die cast Al-U (stand-in for Pu-Al) alloy was increased by 2.5% by vacuum outgassing of the Zircaloy tubing prior to injection casting of the core.

Swaged rod $UO_2$ fuel elements are under irradiation in KER-1, KER-3, and in a

HAPO production reactor process tube. Swaged capsule specimens are under irradiation in MTR and ETR. Swaged $UO_2$ rods for near-prototype testing in VBWR are in the final stages of fabrication.

Analysis of gas from $UO_2$ specimens irradiated in MTR disclosed a high molar percentage of hydrogen, 63%. Sorption of hydrogen during the hydrogen atmosphere sintering of $UO_2$ will be investigated.

PRTR Phase III design was completed on schedule September 2. Award of the contract by AEC-HOO is expected November 1. Design of PRTR Phase II-A, which includes the river pump and condenser structures, has also been completed.

PRTR Phase I construction is 15% completed. Phase II construction is 5% completed. No firm price bids were received for fabricatinn of PRTR Zircaloy-2 process tubes; a negotiated contract will be necessary.

The VALPROD reactivity study for spike Pu loadings in PRTR has been completed. Calculation of the maximum rate of reactivity gain due to burnout of Xe-135 shows that the gain is easily controllable.

Plutonium Fabrication Pilot Plant design is 57% completed. Construction is 8% complete. The list of equipment at HAPO which is to be relocated in the PFPP has been revised. The swaging machine has been received and is being tested.

2. Chemical Research and Development

"Mini" unit experiments and more basic tests on neptunium chemistry formed the basis for flowsheet recommendations for recovery of neptunium from the Purex plant. Laboratory purification of the plant concentrates by anion exchange showed $UX_1$ (Th-234) contamination in addition to expected plutonium. A subsequent cation exchange step was found to be effective for thorium removal.

Progress on pyrochemical studies includes a potential "open pot" method of reducing $PuCl_3$ to plutonium metal by reacting the salt dissolved in molten NaCl-KCl eutectic with magnesium - added as a Zn-Mg alloy. Also it was found that thorium impurities can be effectively removed from aluminum-uranium alloy by contacting the molten alloy with molten $KAlCl_4$ with the thorium distributing to the salt phase. This latter result may have application in cleaning up $U^{233}$ containing fuels which inherently build up undesirable radioactivity through a daughter chain involving Th-228. Continued study of the thermodynamics of double salts and metals is also reported.

Work on high level wastes includes more study of Purex waste calcination, both by trough and spray calciner methods. Reduction of waste volume by destruction of the nitrate present includes results on an electrochemical process. Pilot plant nitrate destruction by formaldehyde addition is nearing start-up. Work continues on the simulation of high level waste leaks in buried tank prototypes.

Fission product recovery studies include favorable results on the precipitation of strontium as the nitrate out of typical plant waste (IWW). Liter-scale chemical tests of the IWW waste has characterized the solids observed in the samples as primarily silicic acid. The engineering development of the Cs Packaging Prototype Facility is proceeding.

A controlled potential coulometry analytical procedure for neptunium showed favorable initial results. The method has also been expanded for plutonium analyses to include direct determination of plutonium in dissolver solution.

Darex pilot plant operation continued to show stainless steel passivation effects which are not completely understood. Methods of preventing passivation or of activating passive material are desirable and initial results along these lines are reported.

Other activity on the Non-Production Fuels Reprocessing Program includes studies of the compatibility of stainless steel containing feed solutions with various Redox processing schemes. A cooperative arrangement with ORNL has been established for engineering scale feasibility studies on typical Redox packed columns receiving NPF feeds.

3. Physics and Instrument Research and Development

Dissolver batches of I and E slugs containing 0.95% U-235 (E metal) may be safely increased from 1.7 tons to 2.8 tons according to initial analysis of data obtained from ORNL on criticality experiments in a dissolver mockup. This conclusion may be modified as further data are obtained in this series of experiments.

Additional critical mass measurements were made for simulated dissolver situations with 3% enriched fuel elements. With shorter slugs, 16 inches instead of 24, 18% smaller critical masses were found.

Our knowledge of how neutrons approach thermal equilibrium with the matter they penetrate was advanced by an experiment in which one part of a PCTR core was kept at the temperature of liquid nitrogen while the rest was left at room temperature.

At the request of IPD, experiments were begun to determine the reactivity changes produced in B, D, F type reactors by replacement of solid elements by I and E fuel. This work supplements previous experiments in K type lattices and in C type process tubes.

Arrangements were completed for a cooperative research program in atmospheric physics with the Air Research and Development Command, U.S.A.F., and testing equipment designs for this program was begun in the field.

The determination of uranium in human lungs by direct counting of the subject is hampered by lack of knowledge of "normal" backgrounds to be expected with HAPO personnel, according to results of an experimental study.

In the basic data field, the acquisition of a sample containing 96% Pu-241 is expected to allow improvement in our knowledge of the fission cross section of this material. The two mass spectrometers being constructed are nearing completion; the permanent magnets have been energized. An improved method for measuring the voltage of the Van de Graaff generator was invented.

Satisfactory progress was made on the many development projects in the radiation monitoring field.

4. Biology

No important changes in activity densities of wildlife occurred during the month.

$P^{32}$ studies indicate that the ovary may qualify as the critical organ instead of bone.

DTPA, although somewhat more effective than EDTA in promoting the removal of plutonium from the body, should not be administered without caution. Another laboratory has indicated that its toxicity is significantly greater than EDTA.

A new and small problem was started to test the ability of fruit flies to sense ionizing radiation. The experiment includes attempts to allow natural selection to increase the population of sensitive members.

5. Programming

Work was begun on the possibilities, timing, and costs of decontamination and recovery of irradiated and unirradiated neptunium-237 and plutonium-238.

A study stage project cost of $1,100,000 was estimated for Hastelloy-F facilities suitable for the nitric acid-hydrofluoric acid dissolution (Niflex process) of stainless steel and Zircaloy clad power reactor fuels.

A Comparison of plutonium with uranium-235 as uniform enrichment in uranium-238 fuel at constant $\Lambda$ has again established the superiority (higher attainable MWD/T) of plutonium for two specific cases.

A request was submitted to the AEC to make available to the Laboratories the plutonium from the fuel plates now being irradiated in the MTR and from the first PWR blanket.

The detailed charge-discharge schedule for the first two years of PRTR operation has received general acceptance by all HLO components.

Technical and Other Services

Since distribution of the radiation exposure cards to all employees early in August, a total of 22 inquiries has been received and appropriately acknowledged. Of these 22, four requests for further information indicated minor errors in the total dose which were reported to the involved employees. The primary difficulty in these cases was that part of the working histories was as AEC or construction employees as well as General Electric employees.

Iodine emission rates from the separations stacks were maintained at levels well below the control limit of 10 curies per week. Measurements of $I^{131}$ on vegetation outside of the plant perimeter were below the detection limit of $1.5 \times 10^{-6}$ μc/gram. Decrease in fallout from bomb testing and decay of previously deposited materials resulted in an over-all general reduction in fission products measured on environmental vegetation.

Statistical and mathematical assistance on 17 separate problems was given within HLO and to other departments and operations. Of particular interest were the

design and analysis of an experiment to evaluate the effects of 5 process variables on total bond count, a recommendation for a change in the existing tolerance limit statements of final product, and analysis of a number of NFR design experiments on the physical properties of zirconium alloys.

Work on the CPD control study has centered about the feasibility of using larger material balance areas for accountability control coupled with increased informal material control within these areas.

A high level of activity on Washington Designated Programs was continued throughout the month.

There were 22 authorized projects (exclusive of PRTR and PFPP) at month end with total authorized funds of $4,747,300. The total estimated project cost of these projects is $8,923,800. One project was completed during the month. One project is awaiting AEC authorization. Project proposals for nine new projects are in preparation.

Construction of the High Level Radiochemistry Cell was started on August 14. Construction completion is scheduled July 1959.

Supporting Functions

An Interim Control Budget for FY 1959 has been established for HLO Level 3 and Level 4 components. The control budget deviates from the Preliminary Financial Plan for programs that are expected to be adjusted in the firm plan which is expected in September.

A number of approval letters covering memberships on standards committees were submitted to the Commission. Two of these were recalled for more specific data on costs and a statement concerning the qualifications of the nominee. Another letter covering the University of Washington's proton energy loss research has been delayed because of legal questions concerning the contract reference shown in the letter.

Sample reports covering the employee attitude indicators were finished for review by management. A unit cost index for Bioassay has been accepted by management and procedures for its routine reporting have been established in Cost Accounting.

At month's end, the staff of the Hanford Laboratories Operation totalled 1232, including 584 exempt and 648 non-exempt employees. There were 518 exempt employees possessing technical degrees, including 284 BS, 109 MS, and 105 PhD.

The 1958 Summer Institute of Nuclear Energy was concluded on August 15, and the AEC Radiological Physics Fellowship Program terminated August 22. Feedback for both Programs was very favorable.

Placement of personnel scheduled for layoff continued very favorably during the month. It is anticipated that only four to six persons of the original twenty-three scheduled for layoff in RPO will be placed in lack of work status at the end of September.

Negotiations were resumed with the Regional Monitors during the month and meetings are planned for September.

Laboratories personnel worked a total of 185,000 man-hours during the month with no disabling injuries. Since September 1, 1956, a total of 4,525,000 man-hours have been completed with no disabling injuries. The medical treatment frequency for August was 1.83 as compared with 1.18 during July.

There were 2 security violations during the month, bringing the total for the calendar year to 34.

H M Parker

Manager,
HANFORD LABORATORIES

HM Parker:kss

REACTOR AND FUELS RESEARCH AND DEVELOPMENT OPERATION

TECHNICAL ACTIVITIES

## A. FISSIONABLE MATERIALS - 2000 PROGRAM

### 1. METALLURGY PROGRAM

#### Corrosion Studies

Etching and Rinsing of Zircaloy. Development work continued on the aluminum nitrate rinsing procedure reported in June and July. The recommended temperature for the aluminum nitrate-nitric acid rinse bath has been lowered from 100 C to between 50 and 60 C. During the etching and rinsing of some Zr-2 clad $UO_2$ core fuel rods, it was discovered that with the rinse bath temperature at 100 C, the large heat capacity of the fuel rod caused the surface to evaporate dry very rapidly. This resulted in brown stains which could not be removed by water rinsing. Lowering the rinse temperature to 50 to 60 C avoided this problem.

The effect of more concentrated $HNO_3$ concentrations in the rinse bath was evaluated. Solutions more concentrated than the recommended 25% by volume 70% conc. $HNO_3$ are no more effective and may be harmful. Since acid solutions less concentrated have proved less effective, the recommended acid concentration has been fixed at one part concentrated nitric acid to three parts water.

A number of Zr-2 coupons and some fuel elements have been etched and rinsed by the new procedure. To date no "Acid Staining" has been observed after autoclaving. There is some evidence that after the aluminum-nitrate, $HNO_3$ rinse the water rinses can be rather superficial.

Zircaloy-2 Autoclaving. Zircaloy-2 is autoclaved for two purposes, to test its quality and to put on a uniform hard film. The current standard test conditions for Zircaloy-2 are 400 C, 1500 psi steam, for 14 days. Substantial savings in time and money could be realized if the tests would be significant under less severe conditions. Reducing the temperature to 360 C gives a different film and does not serve as an accelerated test. Tests at 400 C, 20 psi steam, for 2.2 days gave weight losses very similar to standard, and a film of excellent appearance, but did not give the sharp distinction between good and bad Zircaloy-2 that the standard conditions give. Tests at 400 C, 1500 psi steam, and three days give results very similar to the 14-day tests. Tests at 400 C, 800 psi, and three days also give good films and good detection of off-standard Zircaloy. Hence, a less severe test may result in good coatings and good discrimination, but any such test must be calibrated against service conditions.

Aluminum Corrosion Mechanism. At elevated temperatures, aluminum corrodes in water in a uniform manner which follows a parabolic rate law. After a period of time, termed the induction time, the process changes to a linear

mechanism which rapidly destroys the aluminum. Several experiments have been conducted to determine the cause of the change in mechanism.

Samples of 1245 aluminum (standard Hanford can stock) were corroded in water at 275 C along with control samples of X-8001. At regular intervals samples of both alloys were removed, bent around a curved mandrel, straightened, and replaced in test. Other samples were hammered and replaced in test. Although both of these processes mechanically damaged the corrosion product film, there was no effect on the induction time or corrosion rate.

Dehydration analyses were made of corrosion product films formed on 1245 and X-8001 alloys at 240 C in water. The water content of the film was about 20% for both alloys and did not change with the change in corrosion mechanism.

The surface area of samples of corroded 1245 and X-8001 alloys was measured by nitrogen adsorbtion. The samples were exposed to water at 290 C. The samples were removed from test at 5, 10, 15, 25, 35 and 50 minutes for weighing and surface area measurement. The induction time for the 1245 alloy was about 15 minutes. Although there was a rapid increase in surface area during the rapid linear corrosion process, this increase did not occur until 15 or 20 minutes after the change in corrosion mechanism had occurred.

The results of the three foregoing experiments indicated that neither mechanical breakdown nor a change in hydration or surface area can satisfactorily account for the change in the corrosion process which occurs at the end of the induction period.

Jet Impingement Corrosion of Aluminum. A jet impingement apparatus has been constructed to compare relative sensitivity of aluminums to erosion-corrosion. The apparatus consists of a pump, pressure control, pressure ballast, steam heat exchanger and a jet nozzle. Tests are being conducted to determine whether the high-temperature aluminum alloys are more susceptible to erosion-corrosion than 1245 alloy. The results obtained to date are shown in the following table:

JET IMPINGEMENT TESTS
300 Area Process Water - 4 Hours

| Velocity fps | Alloy | Penetration Max. (mils) |
|---|---|---|
| 222 | X-8001 | 18.9 |
| 222 | 1245 | 20.1 |
| 178 | X-8001 | 7.7 |
| 178 | 1245 | 10.1 |
| 122 | X-8001 | 4.74 |
| 122 | 1245 | 2.05 |
| 89 | X-8001 | 4.0 |
| 89 | 1245 | Surface Roughening |

All tests were run at 100 C with a 0.009-inch diameter nozzle. All alloys tested to date have been in the H-14 condition and have been situated 1/4-inch from the nozzle outlet. The penetration has been measured using a calibrated microscope. The first three sets of samples were tested at relatively high velocities, and any corrosion effect was evidently masked by the erosion. Differences in penetration of the alloys at these high velocities may have been due to differences in hardness of the metal. When the velocity was lowered to 122 feet per second, the erosion-corrosion effect previously noted on high alloy aluminum here and at other sites became apparent. The penetration of the X-8001 was approximately twice that of the 1245. At 89 fps X-8001 showed well defined areas of penetration while the 1245 alloy was roughened with a maximum penetration of very small areas to 0.4 mil for the seven-hour test. The data in the table, above, include only the four-hour tests in process water. However, distilled water, or longer or shorter times, gave results leading to the same conclusions.

X-8001 Cans From Cast Blanks. One-month corrosion data have been compiled for Hunter-Douglas X-8001 cans impact-extruded from cast blanks. Cans were formed from the as-cast blanks, cast and annealed blanks, cast blanks forged to size, and cast blanks forged to size and annealed. Corrosion results in 360 C deionized water after one month were similar for all cans. The corrosion losses from can samples were favorable in comparison with wrought X-8001 sheet.

Photomicrographs from sections of the cans from the cast blanks were similar. They showed the second phase material to be dispersed in particles of about the size found in production X-8001 cans, but with a tendency to stratify.

Corrosion Behavior of New Aluminum Alloys. Several new aluminum alloys prepared by the Alcoa Aluminum Research Laboratory have been tested in 360 C water. These are listed in the following table along with the initial data on their corrosion behavior:

## CORROSION OF ALUMINUM ALLOYS

One month at 360 C
Deionized Water

| No. | Ni | Fe | Ti | Si | Sb | Corrosion (mils) | Corrosion 1 yr (parabolic) |
|---|---|---|---|---|---|---|---|
| 212272 | 0.38 | 0.36 | - | 0.10 | - | Failed | - |
| 212273 | 1.04 | 1.00 | - | 0.10 | - | 0.87 | 3.0 |
| 212274 | 0.81 | 2.00 | - | 0.10 | - | 0.82 | 2.8 |
| 212275 | 2.01 | 0.74 | - | 0.09 | - | 0.78 | 2.7 |
| 212276 | 1.73 | 1.59 | - | 0.09 | - | 0.63 | 2.0 |
| 212277 | 0.12 | 1.18 | - | 0.11 | - | Failed | - |
| 212278 | 1.39 | 0.11 | - | 0.10 | - | " | - |
| 212282 | 1.56 | 0.93 | - | 0.10 | - | 0.77 | 2.6 |
| 192594 | 1.0 | 0.50 | - | 0.10 | 0.3 | 0.70 | 2.4 |
| C810 | 1.0 | 0.5 | 0.1 | 0.1 | - | 0.86 | 3.0 |
| C811 | 1.0 | - | 0.1 | 0.01 | - | Failed | - |
| C812 | 1.5 | 1.5 | 0.1 | 0.1 | - | 0.76 | 2.6 |
| C823 | 0.6 | 2.0 | 0.1 | 0.1 | - | 0.62 | 2.1 |
| X-8001 | 1.0 | 0.5 | - | 0.1 | - | 1.10 | 3.6 |

There are two objectives in the Hanford Laboratories program for alloy procurement and testing. New lots of previously tested material such as C-810, C-811, C-812 and C-823 are tested for conformity to previous behavior. Secondly, efforts are continuing to produce melts which corrode by a logarithmic rate process. The factors which determine whether or not an alloy corrodes by the logarithmic process are still not known. It is hoped that if more samples having the desired corrosion properties are obtained the nature of the important variables will become more apparent. The logarithmic corrosion process at 360 C can be represented by the expression

$$C + 0.26 \log (0.10\ t\ (hr) + 1).$$

This is less than one mil corrosion in one year.

Certain melts of three compositions have been observed to oxidize in water by this process, for example:

(1) A203X (ANL) 5.5% Ni, 0.3% Fe, 0.1% Ti
(2) 198X (ANL) 1% Ni, 0.1% Ti
(3) IR (Saclay-HLO) 0.6% Ni, 1.7% Fe.

However, the parabolic corrosion behavior of the alloys listed above is typical of most of the promising new aluminum alloys which have been tested.

The Logarithmic Corrosion Equation. Fundamental studies of the aluminum corrosion process have included postulation of a model which expresses the corrosion rate as a function of time. These studies have led to the derivation of the following new equation:

$$x = B \ln \left[ 1 - \frac{A}{C} (1 - \exp Ct/B) \right],$$

where x = the amount of corrosion
t = time
A,B,C, are constants which must be empirically determined, but which have the following physical significance:

A = initial corrosion rate
B = corrosion film thickness to reduce the corrosion rate by a factor of "e"
C = the rate of removal of the corrosion film (e.g., by solution and/or mechanical mechanisms).

This equation, with its three empirical constants, can represent almost any corrosion process which starts at one rate, slows down, and continues at the new, slower rate. However, there are very little corrosion data good enough to justify three empirical constants. In those cases where both the amount of corrosion and the corrosion products remaining are determined, so that C can be determined from data independent of A and B, a three-constant equation is justified. It is expected that the application of this equation to such corrosion data may help in further understanding of aluminum corrosion mechanisms.

Organic Coolant Phase Studies. The study of phase relationships in mixtures of potential organic coolant materials has been completed. The purpose of the study was to investigate all possible mixtures of the purely aromatic hydrocarbons, biphenyl, napthalene, phenanthrene, o-terphenyl, and m-terphenyl, and to determine what mixtures, if any, satisfied the requirements of an optimum coolant mixture. These requirements were that the mixture be liquid near room temperature, 25 C, and that the vapor in equilibrium with the mixture be of such a composition that when condensed at 25 C, it also would be liquid. It was found that no mixtures of the previously listed five compounds satisfies these conditions.

It was necessary to extend the study to include mixtures containing the substituted polyphenyl, monoisopropyl biphenyl, MIPB. The additional requirement was made that an optimum coolant mixture would contain a minimum amount of MIPB and still meet the previously mentioned requirements. An optimum ternary mixture and an optimum quaternary mixture were found and were reported in HW-56921 and HW-57152. These mixtures are given in the following table:

OPTIMUM ORGANIC COOLANT MIXTURES

| Components | Ternary Mixture | Quaternary Mixture |
|---|---|---|
| Monoisopropyl biphenyl | 30.0 weight percent | 14.0 weight percent |
| Ortho-terphenyl | 53.3 | 54.1 |
| Meta-terphenyl | 16.7 | 15.4 |
| Phenanthrene | | 16.5 |

In these mixtures, MIPB is the most volatile component. Any vapors are enriched in MIPB and hence will not freeze if condensed.

Hydriding of Uranium and Zirconium in Organic Coolants. The investigation of the mechanism and kinetics of the hydriding of uranium and zirconium in organic coolant media has been completed, and a report is in progress. It has been found that the uranium reaction proceeds at the same rate and in the same manner in both substituted and unsubstituted polyphenyls (biphenyl and monoisopropyl biphenyl, respectively). At temperatures of 330 C or less the reaction product is beta-$UH_3$ while at higher temperatures, ca. 375 C, the reaction product is uranium monocarbide.

Radiometallurgy Laboratory Studies

Radiometallurgy activities during the month in support of the 2000 Program included (a) annealing and hardness testing on specimens of uranium that were given a short time, low temperature irradiation, (b) the completed examination of one cold-closed slug (PT-IP-112A), and (c) the measurements of an irradiated four-rod cluster of stainless clad natural uranium (KER-3-2). The results and conclusions are reported in detail in connection with the respective development programs involved.

Basic Metallurgy Studies

Recrystallization and Recovery of Zirconium Alloys. The kinetics of recrystallization and recovery in zirconium, Zircaloy-2 and Zircaloy-3 are being determined to establish the optimum conditions of heat treatment during fabrication operations. Percent cold work, temperature, time and heat treat atmosphere have been selected as the independent variables.

Corrosion tests in 680 F water are being run on specimens of Zircaloy-2, argon melted Zircaloy-3 and vacuum melted Zircaloy-3 by the Bureau of Mines, Albany, Oregon. The results of testing these three materials (prior history: heat treatment in vacuum at 300 to 800 C for times of 10 to 1000 minutes) have been reported to 224 days exposure. To date, no marked change in corrosion rate has been noted.

Irradiation Damage and Recovery of Molybdenum. The kinetics of damage recovery in irradiated molybdenum is being studied by x-ray diffraction.

Analysis of recovery data, as measured by decreases in radiation induced lattice parameter expansion, has indicated that the conventional rate equation is not completely valid in the temperature range from 50 to approximately 170 C. A particular value of the lattice parameter does not always represent the same state of the material. This indicates that although a point defect, the interstitial, is being removed from the crystal lattice by a regular and orderly process, a second process must be modifying the annealing kinetics. This second process could be the result of the inhomogeneity of the radiation damage, impurity content of the molybdenum or interactions of the migrating defects with dislocations present in the material before irradiation.

The complicated kinetics which have been observed in the temperature region 100 to 170 C are in harmony with results obtained by D. G. Martin while measuring the changes in resistance of cold worked molybdenum at 100 to 180 C. Above 180 C, thermal annealing effects in the cold worked and irradiated molybdenum are not similar.

It has been reported previously that the remainder of the radiation induced lattice parameter expansion anneals continuously above 300 C and up to 800 C. An estimate based upon several sets of data has been made of the activation energy of this process. A value of E = 2.5 ± 0.5 ev is obtained.

Effects of Low Temperature Irradiation on the Properties of Uranium. The purpose of this test is to find the threshold of detectable neutron damage to uranium through a series of low temperature, short exposures irradiations. Specimens have been prepared from dingot uranium sheet and are being irradiated in the snout facility at 105-KW. Post-irradiation tensile, hardness, and annealing tests will be performed to determine the amount of damage induced and the ease of removal. The irradiations have yielded specimens exposed to from about 0.1 to 30 spike cycles; and yet, the amount of fissioning is practically negligible in the smaller exposures. It should be possible, then, to compare in this study the partial contributions to radiation damage from the dissipated energy from thermal spikes and the lattice distortion caused by fission products.

During the month, as-irradiated hardness measurements were made on two specimens from each exposure. In addition, post-irradiation anneals were given five other specimens and the hardness measured after annealing. If a plot is made of hardness versus exposure time, it is seen that about 83 percent of the total damage observed occurred within one spike cycle, whereas only 17 percent occurred from one to thirty cycles.

An anneal at 300 C and 200 C for 10 hours effected a seven and five percent drop in hardness, respectively, for the lowest exposed specimens (about $3 \times 10^{15}$ nvt). This reveals that the amount of annealing that occurred during the transferring, decanning, and measuring the specimens at room temperature is probably negligible. Anneals at 300 C for 10, 2, and 1 hours caused a drop in hardness of 8, 4, and 1 percent, respectively, for the next level of exposure (about $5 \times 10^{15}$ nvt). Since the ranges of

hardness readings overlap in most cases, a statistical treatment of the data is required before a level of significance can be established for these observations.

Irradiation Effects in Structural Materials. Mechanical property data for irradiated specimens of projected structural metals are necessary for establishing material limitations and optimum conditions for reactor service. A number of potential structural materials for which very limited or no data are available have been prepared for irradiation in a HAPO reactor. These materials include Zircaloy-2, Zircaloy-3, aluminum alloys X-8001 (M-388) and M-257, AM-350 stainless steel, and magnesium alloys HK-31A-H24 and A-3XA-0.

An initial charge of tensile specimens has been irradiated for approximately three weeks at the KE magazine facility to an integrated thermal neutron exposure of $7 \times 10^{19}$ nvt. Five specimens each of Zircaloy-2 and Zircaloy-3 were tested in tension during the month. The specimens were fully annealed prior to irradiation. The yield and tensile strengths of both materials increased about 40 and 12 percent, respectively, which is analogous to about 3-5 percent cold work on unirradiated material. The percent total elongation for Zircaloy decreased about 35 percent and for Zircaloy-3 about 38 percent.

A drop-in-load yield point in the stress-elongation curves for irradiated Zircaloy-2 was consistently observed. The increment of stress between the upper and lower yield points averaged 360 psi which indicates the degree of interstitial "pinning" of dislocations induced by neutron bombardment. Irradiated Zircaloy-3 did not exhibit this behavior.

It was observed that the yield strengths of both irradiated Zircaloy-2 and Zircaloy-3 were sensitive to strain rate. By increasing the strain rate by a factor of 10 (from 0.005 to 0.05 inch per minute), an increase of eight and nine percent resulted in the yield strengths for Zircaloy-2 and Zircaloy-3, respectively.

Production of High Purity Uranium. A study of methods of preparation of high purity uranium is being conducted primarily to provide a supply of this material for use in fundamental physical metallurgy studies. Electrowinning from a molten KCl-LiCl-$UCl_3$ salt bath produces dendrites of uranium which may be fused in a vacuum furnace. The metal obtained from these operations may then be fabricated into the required specimens.

Analyses of samples of uranium consolidated by induction heating indicate corrosion of the stainless steel cathode now being used. Iron, nickel and chromium were present at 180 ppm, 50 ppm, and 50 ppm, respectively. Samples of dendrites have been sent for analysis to determine whether the contaminants are being co-deposited or carried over with the salt cover.

A 2.12-pound ingot was vacuum melted, using material previously consolidated in the induction unit. A sound ingot was found after approximately

1/8" of the top was cut off. The ingot has been sectioned, and portions have been sent to the spectrographic laboratories for analysis.

Irradiation Study of Thermocouples. A knowledge of the errors in temperature measurement using thermocouples in a neutron flux is essential for the quantitative evaluation of the effects of neutron irradiation on materials. Because such information is lacking, a program of measuring thermocouple stability in-reactor is currently in progress. After 1536 hours of exposure in KW Reactor, both the asbestos insulated and quartz insulated thermocouple lead wires show some decrease in leakage resistance between wires. No definite trend has as yet been established, but all readings seem to be decaying from the $10^7$ ohms value previously observed.

Electron and Optical Microscopy. The study of the microstructure of cladding and fuel materials is a direct way of detecting radiation damage in these materials. Two techniques are being used: (1) metallographic examination of polished and etched surfaces, and (2) fractographic studies.

A specimen of uranium irradiated at a temperature of 300 C to a burnup of 0.2 a/o has been studied in the electron microscope. Positive replicas disclosed voids 2000 A in diameter. Studies of negative replicas reveal the presence of additional voids having diameters of 200 to 400 A. These small holes are observed only because they appear as mounds on the negative replica. Similar sized voids have been detected on replicas of fracture surfaces prepared from uranium with a burnup of only 0.026 a/o.

Microautoradiographic techniques have been applied to replicas of irradiated Pu-Al-Si and Pu-Al alloys. The presence of Pu-rich areas are easily determined by the characteristic star-shaped tracks which are superimposed on the microstructure. Replicas of these two alloys were also examined for voids at high magnification in the electron microscope. No voids were detected.

New Fuel Element Development

Rod Cluster Fuel Elements. Four seven-rod cluster fuel elements are being irradiated in the KE Reactor through-hole facility as part of the NPR fuel element development program. These fuel elements are operating at 90 kw/ft with a central core temperature of 310 C. From data collected the uranium stainless steel interface bond coefficient was calculated to be 2,360 BTU/hr/ft$^2$/$^o$F. Last month these fuel elements were operating at 100 kw/ft specific power, 359 C core temperature, and with a calculated bond conductance of 2,580 BTU/hr/ft$^2$/$^o$F. The goal exposure of this irradiation is 2,500 MWD/T of which approximately 1,600 MWD/T has been obtained.

Three seven-rod cluster fuel elements for the loading in the ETR 3x3 loop facility were fabricated and initial pressure drop tests were completed. Pressure drop across the fuel charge was found to be 7.85 psig at a flow of 60 gpm. The basket assembly containing the three seven-rod cluster fuel elements and a four-inch Zircaloy-2 tensile specimen will be shipped to the ETR about the middle of September.

Coextruded uranium-Zircaloy-2 rods are prepared and sealed for eight one-foot seven-rod cluster fuel elements. These rods will be assembled into seven-rod cluster fuel elements for the KER loop facilities as soon as the ID of the process tubes is determined. These fuel elements will act as a backup charge for the present fuel which is scheduled to be discharged March 1959.

Rod cluster fuel elements with uranium cores and stainless steel cladding have been tested in the MTR and at the Hanford KER loops as preliminary checks of the cluster geometry. The post-irradiation examination of the two KER cluster fuel tests is under way. Test KER K-1-2 had an average exposure of 600 MWD/T with a maximum coolant temperature of 270 C. Measurements of two of these rods showed that the outer diameter of one rod increased five mils, while the diameter of the other remained unchanged. Test KER K-3-3 had an average exposure of 2250 MWD/T with a maximum coolant temperature of 235 C. The outer diameter of rods from this test remained unchanged while the length (rods were eight inches long) of the fuel cores decreased from 0.040 to 0.060 inch. KER K-3-3 test results did not indicate fuel swelling for the 0.570 diameter uranium rods clad in 0.030-inch stainless steel jackets undergoing exposures of 2250 MWD/T with maximum core temperatures of 500 C. These test results would not be expected for unrestrained uranium at 500 C according to British data.

Two seven-rod cluster elements using NMI coextruded uranium are now operating in KER loop 1, with maximum coolant temperature of 265 C and specific power of approximately 5.2 kw/ft/rod. The clad thickness is 0.030 inch, the core diameter is 0.570 inch, and the overall length is 13.3 inches. Six of the fuel rods are welded to a triangular end spider while the seventh rod, the center rod, is mounted on a bar supported by the triangle. The rod-to-rod spacing is 0.050 inch while the rod to process tube spacing varies from 0.030 to 0.080 inch. The goal exposure for this test is 1000 MWD/T.

Two fuel elements designed to investigate fuel bowing in a horizontal process tube are operating in KER loop 3. The maximum coolant temperature is 187 C and specific power is approximately 16.7 kw/ft/rod. Both elements are three-rod clusters with 0.030 inch Zircaloy-2 coextruded uranium rods of 0.630 OD. One element is 24 inches in length and is supported only on its ends. The second element is 36 inches in length and has spring supports at the center.

Rod and Tube Fuel Elements. Rod and tube fuel elements are possible fuel element candidates for a Hanford NPR. They are extruded surface fuel elements with symmetrical coolant flow channels which result in good dimensional stability. Nuclear Metals has produced small quantities of experimental tube and about 30 feet of unalloyed uranium with coextruded 30-mil Zircaloy-2 cladding which is of irradiation quality. Its outer diameter is 1.785 inches and inner diameter is 1.375 inches. In addition to the tubing, NMI produced 40 feet of 1.000-inch diameter rod with 0.020-inch Zircaloy-2 clad. Three 36-inch fuel elements using NMI rod and tube

are near completion. Two are for KER standby tube loadings and one is for ETR critical facility measurements. The first ETR 6x9 loading will be a rod and tube element.

Coaxial Fuel Element. The third MTR irradiation of the coaxial concept fuel element is currently in progress. In order to evaluate its irradiation behavior at the initial startup, this temperature monitored coaxial fuel element had an equilibrium axial temperature of 670 C when the heat generation was 88 kw/ft. During subsequent operation to an exposure of about 650 MWD/T with a heat generation of 85-89 kw/ft, the temperature gradually increased to 750 C. This increase in temperature may reflect changes in the heat transfer characteristics of the internal U-U interface. The fuel elements are operating at reduced power during the experiments in which the reactor is powered with Pu fuel elements. If the thermocouples are still serviceable at the conclusion of the Pu fuel experiments, these elements will then be operated at full power. Continued operation of this fuel element will give information regarding performance during cyclic operation (high power-low power-high power).

Self-Supported Fuel Elements. Self-supported fuel elements with collapsible rails attached to the jacket of the element are designed to accurately position the element in a process tube. A production test, IP-84-A, is now being irradiated in B Reactor. Approximately 20 tubes of self-supported elements of the I & E design must be fabricated. A jig design for the resistance spot welder has been developed. This new jig should permit better quality and higher production on these I & E elements.

Uranium-Magnesium Matrix Fuel Material. The dimensional behavior of Zircaloy-2 canned one-inch diameter uranium-magnesium fuel cores is unknown. Previous testing of U-Mg matrix fuel materials gave conflicting data as to its dimensional stability. A one-inch diameter uranium magnesium fuel element has been discharged from the MTR and received by the HAPO Radiometallurgy facility for post-irradiation examination after attaining a calculated exposure of 9900 MWD/T. The fuel core of this element contains 65 v/o uranium in a Mg-Si alloy matrix. Approximately twenty-eight months exposure was required to attain the calculated exposure. A companion piece with approximately 8600 MWD/T will continue to be irradiated.

Closure of Coextruded Rod End Cap by Brazing. In an effort to reduce the fabrication costs of coextruded rod fuel element components the possibility of using brazed end cap closures is being explored. These would eliminate the necessity of machining out the uranium from the ends of the rods thus effecting a marked cost reduction since there would be no problem of uranium alloying.

Good brazing technique requires that the entire surface to be brazed is simultaneously heated to the melting point of the braze alloy. This is most readily done by means of a diffuse heat source which can be made to heat the component evenly. To adapt the electron beam vacuum welder, which features a concentrated point heat source, to brazing studies, a

new electron gun consisting of shaped 0.020" diameter tungsten wire has been designed. This design permits even heating of the entire end of the component to be brazed. Because of the closeness of melting points of uranium and the present braze alloys, temperature must be closely controlled. Further work is being directed towards obtaining lower melting braze alloys and closer temperature control of the heating cycle.

Thermal Contact Conductance. The contact conductance of several systems which are important to fuel element and reactor design were measured. The conductance of a lapped surface of sintered $UO_2$ in contact with a similar surface of $UO_2$ increased from 150 to 460 BTU/hr/ft$^2$/°F as the joint pressure increased from 63 to 440 psi. A joint between aluminum and a machined surface of Zircaloy-2 was found to be quite sensitive to the pressure on the joint. The conductance of Zircaloy-2-aluminum joint increased from 1000 BTU/hr/ft$^2$/°F in a vacuum to more than 30,000 BTU/hr/ft$^2$/°F. The conductance of Zircaloy-2 graphite joints with and without an oxide scale on the zirconium in vacuum and in helium atmospheres were also measured as a function of joint pressure.

Restraint of Uranium Swelling by Zirconium Cladding. To date, no swelling data are available for unalloyed clad uranium with a 250-350 C cladding surface temperature and a 450-600 C maximum fuel temperature. Two experiments were designed for irradiation in the MTR to provide initial swelling data on unalloyed uranium fuel rods coextruded with Zircaloy-2 operating at the above temperature conditions. One fuel rod with an estimated exposure of 2100 MWD/T, GEH 3-31, was discharged and returned to Hanford for examination. The other fuel rod, GEH 3-32, has an exposure of 500 MWD/T at a maximum uranium temperature of 350 C. Neither fuel rod has operated in the desired maximum uranium temperature range of 450 to 600 C. Two additional experimental assemblies, identical to GEH 3-31 and 3-32, are fabricated and will be shipped to the ETR for irradiation. Charging of these experimental assemblies, GEH 3-57 and GEH 3-58, is expected in September. The assembly of a series of capsule experiments designed for irradiation in Hanford reactors has begun. These experiments will determine the dependence of uranium fuel element swelling upon cladding and uranium temperatures, cladding thickness, and exposure. Before final assembly of these capsules, a capsule will be irradiated at Hanford to test the accuracy of the physics and heat transfer calculations.

Direct Casting of Uranium Cores Into Zircaloy Shapes. Casting uranium into Zircaloy cans or tubes is a potentially economical method for producing fuel elements of a variety of geometric shapes. Satisfactory jacket to core bonds must be effected during solidification of the core. Subsequent closure and required heat treatment would then produce a completed element.

During the month one casting was made into a mold holding four Zircaloy-2 cans 1.475-inch diameter with 0.030-inch wall. The mold and Zircaloy cans were heated in the vacuum chamber with a resistance furnace. Thermocouples located three inches from the mold bottom and near the top of the mold indicated that the temperatures at pouring were 695 C near the bottom

and 665 C near the top. The uranium was poured at approximately two microns Hg pressure and 1400 C. The cans were pulled in slightly from the mold wall and approximately 3/16 inch up from mold bottom during shrinkage of the uranium. Sections were cut from these elements to determine the degree of bonding. Examination at 500X showed that a very narrow alloy zone had formed on the zirconium side of the interface, the full length of the slug, and at the bottom. Sections were salt bath beta heat treated as many as three times without fracturing this bond and were also heated in vacuum to 750 C for four hours and slowly cooled without fracturing the bond. Sections of this mold were broken during removal of the slugs and another mold holding one can has been built for additional tests in which the mold temperature will be varied. A mold has also been made for holding a Zircaloy-2 I & E can made up from tubing stock of 1.500-inch OD, 0.035-inch wall, and 0.500-inch ID.

AlSi Bond Strength Evaluation. Twenty slugs, each representing a different combination of AlSi composition and Duplex bath temperature were canned by FPD personnel and were subjected to the "Leak Vulnerability" test to determine what relationship exists between those variables and the slugs rate of failure when purposely pierced through the jacket with leak holes and held in 170 C water. This experiment was run as a preliminary test to determine trends and included only one specimen representing each set of conditions. Test results, however, indicated no definite trend, the conditions of temperature and concentration used in canning appeared to have no bearing on the rate or severity of attack. While the sample was too small for statistical accuracy, it is apparent that some other factor is more influential than either Si concentration or canning temperature in affecting rate of failure in the water autoclave. Experiments are being conducted to identify this more influential factor.

Creep of Pressure Tubing. Equations have been derived which will determine the stress distribution and strain rates in pressure tubing with a logarithmic temperature distribution. The tube is assumed to be internally cooled and undergoing secondary creep. Numerical evaluations can be made for creep rates which are either dependent on a power function of stress or an exponential function of stress. The stress and temperature dependence of the material model for 15 percent cold-worked Zircaloy-2 were determined with creep data from BMI. Calculations made for NPR operating conditions reported in HW-54797 indicate that secondary creep will not be a problem in the process tubes.

## 2. REACTOR PROGRAM

### Coolant Systems Development

KER Testing. All four KER loops are operating with heat-generating fuel elements. The details of the charge and normal operating temperatures may be found in the schedule document, HW-56805. Loop KER-2 is operating at a lower temperature ($< 100$ C) as a result of a leak in the system. It is planned to repair the leak at the next outage.



[redacted]

Inhibitors for Systems Containing Aluminum and Carbon Steel. A test evaluating $Na_2Cr_2O_7 \cdot 2H_2O$ as a corrosion inhibitor in high temperature water has been initiated at 180 C, pH 4.5-5.0, 50 ppm $Na_2Cr_2O_7 \cdot 2H_2O$. Nitric acid is used to regulate the pH. Visual observations after one and two weeks of operation indicate excellent inhibition of X-8001 aluminum and 1051 carbon steel. Some pitting attack was observed on 1032 carbon steel around machined areas. This pitting apparently is not increasing with exposure time. Further testing will be done in the process Corrosion Prototype when it becomes available to determine the optimum dichromate concentration required.

Caustic Embrittlement Studies. The A-212 carbon steel specimen was removed from the caustic embrittlement detector on ELMO-5 and examined for stress corrosion. No cracking was observed after 30 days. This confirms the results of the previous test performed under similar conditions. The only attack observed was due to impinging steam eroding the metal at the point where it escapes the detector. A Type 304 stainless steel specimen was charged into the apparatus to determine the susceptibility of this alloy towards cracking under conditions of high stress and concentrated caustic solutions.

Corrosion of Aluminum Clad Fuel Elements in KER. The aluminum-clad fuel elements from KER-4 have been discharged after 62 days at an outlet temperature of 224 C. The water was maintained at a pH of 4.5 by addition of phosphoric acid. The corrosion rates were on the order of 0.10 mil/month, compared with the corrosion rates experienced in deionized water (H-Loop) of two to four mils/month at equivalent temperatures. These results are more qualitative than quantitative since the total corrosion ($\sim$0.2 mil) was so low that precise determination of corrosion and retained film was impossible. The lower corrosion rates (than H-Loop) are attributed to the combined effects of lower pH and the inhibiting effect of phosphate. As a result of the extremely low corrosion rates which have been experienced in the inhibited systems in KER, new calculations are being made which will permit longer irradiation of aluminum-clad fuel elements at higher temperatures. Only under these more severe conditions can any quantitative data be obtained. On the basis of the results obtained so far, a suitable test would be the exposure of the elements at 280 C outlet temperature for a minimum of six months.

Determination of Aluminum Surface Temperatures. A Doe alloy M-388 clad thermocouple slug with three thermocouples 120° apart in the cladding was charged into the high flux zone of KER Loop 4. Some difficulty was encountered in pushing the long thermocouple train into the process tube, and hence modifications are being made in the charging procedure to eliminate these difficulties. Two of the thermocouples agree within 4 C and show the cladding temperature to be about 50 C higher than the bulk outlet temperature. The other thermocouple reads 15 to 20 C lower than the other two. This temperature difference is probably a result of the differences in thermocouple locations. If this program is successful, it may be possible to determine quantitatively the effects of power generation and film buildup on temperature differential between the aluminum surface and the bulk water.

Another thermocouple slug of the same design is being fabricated as part of the next phase of testing. This piece will be used for the next charge; it will also be available as a replacement in case the charges from KER-2 or KER-4 are discharged prematurely.

Preliminary plans have also been made to put permanent thermocouple wiring from all loops to the X-2 level during the extended KE outage if wiring can be obtained in time.

Raw Water Heat Exchanger Studies. After 20 days operation with raw cooling water at 7 fps velocity, inlet temperature 68 F, outlet temperature 212 F, and maximum pipewall temperature of 310 F, a five percent reduction in the overall heat transfer coefficient has been noted. Each of the three heat exchanger sections was taken apart, inspected, and scale samples were taken. Scale on all of the heat exchanger surfaces was about three to four mils thick. On the low temperature surfaces, the scale was flaky and came off quite easily. At the highest temperature portion the scale was very tenacious and did not flake when scraped. Results of the scale samples with the approximate temperatures are shown below:

| Sample # | $CO_3$% | Ca% | Fe% | Bulk Water Temp. F | Pipe Surface Temp. F |
|---|---|---|---|---|---|
| 1 | 1.5 | 0.1 | 73 | 107 | 227 |
| 2 | 5.9 | 0.5 | 91 | 152 | 262 |
| 3 | 2.1 | 2.0 | 61 | 210 | 310 |

On the basis of these results it is tentatively concluded that the deposition of a calcium carbonate scale is not of serious consequence at these temperatures.

Organic Studies. The pyrolysis rate of isopropylated-Santowax OM (ISOM) has been established as a function of temperature. In general, ISOM has about the same thermal stability as MIPB. The activation energy for pyrolysis was measured to be 72 kcal/(mole)($^{\circ}$C), which is the same value as for the three terphenyl isomers.

The pyrolysis studies of benzene have also been completed. This substance polymerizes ten times slower than biphenyl. The activation energy is 93 kcal/(mole)($^{\circ}$C), which is about the same as the values reported for condensed ring aromatics in the literature. However, this value is higher than the values reported for decomposition (rather than polymerization) of benzene under the action of pyrolysis.

Nonmetallic Materials Development

Graphite Development. Purity tests in the Hanford Test Reactor have been completed on experimental graphites from the Speer Carbon Company and National Carbon Company. The purpose is to evaluate the effect of new raw materials and variations in processing methods on the final graphite purity. The results of these tests are:

1. Resin impregnates used to decrease permeability did not affect purity when followed by AGOT re-graphitization. However, when followed only by a 950 C bake, purity was too low for reactor use.

2. Bars in sizes up to 16-1/2" x 16-1/2" x 50" were AGOT processed with purity comparable to 4" x 4" x 48"material.

3. Increasing the size of the furnace loading over that normally used did not affect purity.

4. A new type resistor used in packing a furnace loading of standard AGOT resulted in purity too low for reactor use.

5. Additives to the base mix to increase density did not affect final purity.

6. A chlorine purification process produced material of purity equal to "F" processed material.

Arrangements have been made with National Carbon Company to irradiate graphite samples made from alternate coke sources to determine their dimensional stability. One coke is similar to the Kendall coke (previously used but now unavailable) and may have properties of particular advantage in high temperature applications. Irradiations of these samples will be completed in time to allow their being considered for use in the NPR if testing is started soon.

X-Ray Studies of Radiation Damage in Graphite. Prior attempts at determining the energy of formation of interstitials and the interstitial position in graphite had been made by Dienes [J. of Appl. Phys. 23, 1194 (1952)] assuming a perfect lattice. No relaxation of the lattice was assumed, although it seemed that when some estimate could be made of the degree of relaxation, a second computation would be justified. From cold neutron scattering measurements of the interstitial concentration and the x-ray intensity measurements of the percentage of disordered material, it is estimated that approximately ten atoms would be in the disordered region around an interstitial. Calculations were repeated both with and without relaxation of the lattice for two possible interstitial sites: (1) interstitials directly over the center of the hexagons formed by the carbon atoms in a layer and just below the mid-plane between layers, (2) interstitials located in the mid-plane and midway along the $a_o$ direction. The results indicated that the first position, previously believed to be the lowest energy position, was not the lowest energy position for interstitials even without any relaxation of the atoms. With relaxation of the atoms, the second position was definitely the lower energy site. These results are applicable to the interpretation of the intensity of x-ray diffraction lines of irradiated graphite.

A portion of the computation necessary for the Fourier analysis of the x-ray diffraction lines from irradiated graphite has been completed. This portion involved the inversion of a 32 x 32 matrix which yields a correction, arising from geometrical and polarization factors, to the Fourier coefficients for the (002) graphite peak. This correction will be applied to the coefficients computed from the data. In addition, the programming of the routine for the computation of the Fourier coefficients on the IBM 650 has been completed.

Stored Energy Monitoring. Measurements on the total stored energy of cores removed from an uncooled graphite channel in DR Reactor have been completed. These samples are representative of the filler block graphite which operates at 450 to 550 C. The amount of stored energy found varied from 20 to 55 cal/gm depending on the position along the channel. This is some 25% less than the amount previously predicted from $C_o$ measurements. This amount of energy could not result in a spontaneous increase in graphite temperature. Cores have been removed from other parts of this and other Hanford reactors and total stored energy is now being measured on these samples.

## Structural Materials Development

Zirconium Tubing for Present Reactors. Several vendors were contacted to determine their requirements for developing fabrication processes to produce ribbed and ribless Zircaloy-2 tubing suitable for retubing the present Hanford production reactors. Contracts were negotiated with Allegheny Ludlum Steel Corp., and with Harvey Aluminum to conduct development programs at their own expense, except that HAPO will furnish the zirconium metal. Considerable confidence was expressed by the vendors that firm priced bids would be possible early in 1959. A proposal for additional work is expected from Superior Tube Co.

NPR Type Tubing. Those companies interested and capable of producing NPR type Zircaloy-2 process tubes were contacted to determine what further development work was required to permit them to bid with confidence on a production size order of this tubing. The Chase Brass and Copper Company wishes to perform additional experiments on extrusion, welding, and drawing, and a contract was negotiated with Chase wherein Hanford will supply zirconium sponge and scrap and Chase will bear all fabrication costs. Similar proposals are expected from Tube Reducing Corporation, Mallory Sharon Metals, Allegheny Ludlum Steel Corporation and Hunter Douglas Aluminum Company.

## Thermal Hydraulics Studies

Reactor Flow Hazard Studies. Four additional experiments were run simulating the thermal hydraulic events following a rupture of a front hydraulic connector to a process tube at C Reactor. These experiments were conducted using a "C" size I & E heater rod in a "C" process tube in the 189-D heat transfer apparatus. The rupture incident was simulated by valves which simultaneously shut off the flow to the tube and vented

the coolant within the tube to the atmosphere. Approximately 2.5 seconds after the water loss, the heat generation was decreased at a rate corresponding to a reactor scram. Temperatures of the heater rod and coolant, pressures, and flow rates were all recorded on high speed recorders during each run. The results to date were for 1000 kw tube powers and 120 C outlet water temperatures and indicate heater rod temperature very close to the melting point of aluminum. However, it is felt that the simulation of reactor conditions was overly severe so plans were made to modify the apparatus to a closer simulation of actual reactor conditions.

Thermal Cycling Tests for GE-ANP. Special heat transfer experiments were completed for GE-ANP. The experiments were performed to evaluate the stresses during thermal cycling of a pressure tube specimen which is a scale model of an in-reactor tube scheduled for use in the ETR.

The Inconel specimen was 21.9 inches long, 3.1 inches OD with a wall thickness of 0.093, and had a welded seam along the length. The specimen was electrically heated in a special apparatus arranged in 189-D where the current from the large motor generator sets was available. The heat generation was 202 watts/gram which produced a heat flux of 1,240,000 B/hr/sq ft from the outside surface to the cooling water flowing in annular flow along the specimen. The average water temperature during cycling was 105 F while the temperature on the inside wall of the specimen reached 780 F during the heating cycle.

The thermal cycling consisted of increasing the heat generation within the specimen until the required heat generation rate and inside wall temperature were achieved. The power input was then dropped to zero and after equilibrium conditions were reached, the heat generation was again increased. Operation was on a twenty-four hour basis for a one week period. A total of 5000 cycles were completed.

Hydraulic Studies. Hydraulic characteristics were determined for two new sizes of K Reactor I & E fuel elements. The K-III-N is an eight-inch normal uranium element with 1.460-inch OD and 0.385-inch ID. The K-III-E is a six-inch enriched uranium element with 1.454-inch OD and 0.400-inch ID. The results of the hydraulic characteristics were presented in HW-56989.

A paper was prepared for presentation at a General Electric Company Symposia on "Test Techniques in Heat Transfer and Fluid Flow," to be held on September 30, 1958, in Schenectady. The paper, HW-46946, "Methods for Investigating Critical Discharge Phenomena with Saturated Water," describes experimental procedures and techniques which have been found convenient to use in the investigation of critical flow conditions for a piping assembly. Some Hydraulic Laboratory data are presented as examples to illustrate the techniques.

Critical flow studies in short sharp-edged flow nozzles have been continued. Both subcooled water and two-phase steam-water mixtures have been investigated in nozzles 1/2", 3", and 5" in length with a 0.469" bore.

The pressure profile along the length of the five-inch nozzle for two-phase flow indicates a limited degree of pressure recovery downstream of the vena contracta. The pressure recovery seems complete at about three diameters downstream. Beyond the recovery point, the pressure begins to drop and this nozzle section is acting as a section of horizontal pipe carrying a two-phase mixture. It is thought that critical flow occurs in two locations in this nozzle when passing a steam-water mixture. First, the choking action of critical flow must exist at the vena contracta and, second, critical flow seems to exist at the exit as pointed out by the steep pressure gradient at the nozzle exit. Experimentally, all that can be said is that critical flow exists at least once in the section.

Assuming that critical flow does occur at the end of the nozzle, the following calculations were performed: (1) exit quality was calculated on the basis of extrapolated discharge pressure and an isentropic expansion, (2) the actual flow rate compared to that predicted by theory. The discharge rates were always greater than predicted from theory by a factor of 1.9 to 2.6.

High Pressure Heat Transfer Apparatus. The reconditioning of the Ingersol-Rand recycle pump was completed and the performance of the pump was checked at high temperatures and pressures. It was found that even though the pump seals had been completely replaced, an excessive amount of injection water was passing through the seals. This means that it will be impossible to hold the system pressure at 2000 psia at near saturation temperatures. The manufacturer was contacted concerning the situation.

## Mechanical Equipment Development

Organic Cooling System Components. The MCTS-1 facility operated at temperatures between 575 and 665 F during the month. All four mechanical seals were removed for inspection and replacement of worn parts. The Duraseal had a scored shaft at the contact point of the teflon shaft seal and worn teflon shaft seal "V" rings. The Sealol graphite ring had a shattered skirt. The faces of the Byron Jackson seal were deeply scored due to insufficient cooling by the seal pumping ring. Due to the short running time of the John Crane seal, no signs of wear were observed. After renovation of the seals, a seal life test will be run.

## Shielding Studies

Attenuation Studies. A fast neutron relaxation length of 7.19 cm has been obtained for ferrophosphorus concrete (density of 4.83) in the as-cured condition. Further details are reported in "Shielding Properties of Ferrophosphorus Concrete" (HW-56988, E.G. Peterson). The test slabs, after being baked at 100 C, are now being irradiated in the test well. The experiments on ordinary concrete baked at 100 C are being analyzed, and the test slabs are being baked at 200 C.

A formal report, Radiation Damage to Concrete," (HW-56195, R.G. Clark) was issued.

Fast Neutron Spectrometer. The manufacturer of the 100-channel analyzer has sent an engineer to Hanford and most of the faults have been corrected. The unit is operating and is being checked for marginal operation.

B. WEAPONS - 3000 PROGRAM

Research and development in the field of plutonium metallurgy continued in support of the Hanford 234-5 Building Operations and weapons development programs of the University of California Radiation Laboratory (Project Whitney). Details of these activities are reported separately via distribution lists appropriate to weapons development work.

C. REACTOR DEVELOPMENT - 4000 PROGRAM

Gas Cooled Power Reactor Program

Graphite Studies. A revised Hanford research and development proposal for GCPR graphite studies was completed. The primary purpose of the proposed program is to secure improved knowledge of the reaction of gas coolants with protected and unprotected graphite over a range of conditions of practical interest for gas cooled power reactors, and to devise means to maintain high gas temperatures in such reactors with tolerable damage to the graphite moderator. This program will also include efforts in areas other than coolant-graphite reactions. Examples of such items are graphite contraction, graphite development and procurement, thermal conductivity, strength, and diffusion of fission products in impregnated graphite.

An in-reactor recirculating gas loop has been included as part of the proposed program. The feasibility of installing a $CO_2$-graphite loop in one of the production reactors has been reported by Process Design Operation, IPD, in HW-56546. Further study indicated that a more favorable location for the gas loop is the PRTR. The loop as presently scoped by the Design Development Operation, HLO, will consist of in-reactor and ex-reactor test sections, gas bearing compressors, heaters, make-up facilities and necessary pressure and temperature control devices. The loop design pressure and temperature are 500 psig and 1100 F, respectively. Studies will be continued to determine the additional cost and equipment required to accommodate small amounts of fissionable material in the loop.

D. CUSTOMER WORK

Radiometallurgical Examinations

I & E Natural Failure (RM-243). Examination of a natural uranium I & E fuel element failure from tube 3849-KE (624 MWD/T, failed 5/10/58) was completed. Metallographic examination of two jacket sections revealed severe intergranular attack at the edge of the hot spot crater and moderate attack 1/2 inch from the crater edge toward the center of the slug. Spheroidization of the silicon in the AlSi of the section from the edge of the crater was observed. Temperatures of 325 C to 375 C in this area were estimated on the basis of the microstructure observed. No silicon spheroidization was detected in the other section.

IP-81-A Blunt Nosed True Line Solid X-8001 Rupture From 105-DR (RM-228). Examination of the X-8001 (e.g., M-388) jacketed, blunt nosed true line solid production fuel element rupture from 105-DR has been completed. It is concluded that failure of the piece occurred as a result of misalignment of the fuel element column. Indentations on the female end of the rupture showed that the male end of the piece immediately upstream from the rupture was cocked away from the ribs. The piece was approximately 0.070 ± 0.010 inch out of line. The reduced water flow in the upper portion of the annulus caused heating of the fuel element on the upper side which led to the failure of the X-8001 jacket.

IP-148-AC Examination of Rupture from 0957-C (RM-247). An internally and externally cooled, enriched, fuel element rupture from tube 0957-C was shipped to the Radiometallurgy Laboratory August 8, 1958, for examination to determine the cause of failure. The piece was irradiated to 870 MWD/T and had 108 days of effective operation. Visual examination of the slug showed the uranium had split longitudinally. The cleavage extended from an area one and one-half inches from the female end between the rib marks, across the slug diagonally, to an area three-fourths of an inch from the male end, directly opposite the rib marks. Striations of the jacket indicated further fracturing of the uranium had occurred.

Near the male end of the slug the jacket appeared to have been heated over an area three inches in length and one inch in width. The heated area was directly opposite the ribs on the upper portion of the slug.

Coolant Systems Service Testing

The mockup tube system was recently revised to permit testing of "RTD's" (Resistance Temperature Detectors) for the K Reactors. A previous test at 140 C in process water caused a failure in the silicone rubber seal around the RTD. The new testing includes four elements at 120 C and 50 gpm in process water and 14 elements at 140 C and 30 gpm. A Marmon-Conoseal type NPR cap seal failed after about six cycles from 300 to 500 F and was removed from the ELMO-7. A bell-ring type NPR cap seal has cycled 385 times between

Samples Processed During the Month

| | |
|---|---|
| Total samples processed | 328 |
| Photographs | |
| Micrographs | 297 |
| Macrographs | 106 |
| Total | 403 |

The following Trips and Visits Reports apply to activities on 2000, 3000, and 4000 programs. Technical activities on the 4000 Program - Plutonium Recycle Test Reactor are reported separately in HW-57225 A2.

F. W. Albaugh

Manager, Reactor and Fuels Research
and Development Operation

FW Albaugh:kb

## VISITS TO OTHER INSTALLATIONS

| Name | Dates of Visit | Company Visited and Address | Reason for Visit | Personnel Contacted | Access to Restricted Data |
|---|---|---|---|---|---|
| FW Albaugh<br>RM Fryar | 8/19-21<br>8/22 | GE-APD, Schenectady<br>GEL & Research Lab. | Technical discussions<br>" " | WE Johnson<br>CJ Suits | No<br>" |
| JM Batch | 8/21 | ANL, Lemont, Ill. | Heat transfer problems | TR Bump | " |
| JC Fox | 8/7-8 | General Mills, Inc., Minneapolis, Minn. | PRTR Fueling Vehicle Design | G Kelly | " |
| HK Nelson | 8/22-23 | Minneapolis-Honeywell, Philadelphia, Pa. | PRTR Automatic Controller Contract & Design | B Dahlin | " |
| DJ Foley | 8/25/28 | Consolidated Western Steel Corp., Los Angeles, Calif. | Calandria fabrication | DJ Bentley | " |
| RM Fryar | 8/23 | Minneapolis-Honeywell, Philadelphia, Pa. | Vendor meetings on PRTR control | -- | " |
| LG Merker | 7/29 | Kux Mfg. Co., Chicago, Ill. | Engineering conference | J Kux | " |
| | 7/30 | Sutton Eng. Co., Pittsburgh, Pa. | " " | W Larson | " |
| | 7/31-8/1 | F.J. Stokes Corp., Philadelphia, Pa. | " " | D Garwood | " |
| | 8/4-5 | Fenn Mfg. Co., Hartford, Conn. | " " | J McMartin | " |
| | 8/6 | Heald Machine Co., Worcester, Mass. | " " | R Anderson | " |
| | 8/8 | Loewy Hydrapress Div. of Baldwin-Lima-Hamilton, New York, N.Y. | " " | Mr. Mayer<br>J Sanders | " |
| | 8/9 | Loma Machine Mfg. Co., New York, N.Y. | " " | AI Nussbaum | " |

## VISITS TO OTHER INSTALLATIONS (CONT)

| Name | Dates of Visit | Company Visited and Address | Reason for Visit | Personnel Contacted | Access to Restricted Data |
|---|---|---|---|---|---|
| B Mastel, Brock | 8/4-6 | Los Alamos Sci. Lab., Los Alamos, N.M. | Electron microscopy & diffraction problems | EC Kalmus | Yes |
| | 8/7-9 | Electron Microscope Soc. of America, Santa Monica, Calif. | Present paper | -- | No |
| WV Cummings | 8/13-15 | Conference-Industrial Uses of X-ray Analysis, Denver, Colo. | Present paper | -- | " |
| DC Kaulitz | 8/14 | Phillips Pet. Co., (MTR) Idaho Falls, Ida. | Design problems | R Neidner<br>S Cohen | " |
| B Mastel | 8/20-22 | GEL, Schenectady | Consult on R&D program | ZD Sheldon | Yes |
| DC Kaulitz | 8/26-29 | Phillips Pet. Co. & AEC-IOO, Idaho Falls, Ida. | Inspect & assemble in-reactor assembly for 3x3 position | S Cohen | " |
| DL Zimmerman | 8/21-24 | Vallecitos Lab., Pleasanton, Calif. | Interview | R Trevithic | No |
| RC Giberson | 8/9-16 | MIT, Cambridge, Mass. | Class in Infrared Spectroscopy | RC Lord | " |
| | 8/18 | GE, Pittsfield, Mass. | Discuss plastics & thermocouples | JF Mizia<br>LB Moody | " |
| | 8/19 | GEL, Schenectady | " | AI Dahl | " |
| JM Davidson | 8/20-22 | Phillips Pet. Co., Idaho Falls, Ida. | MTR conversion & Hanford programs | R Neidner | Yes |
| RE Nightingale<br>TK Bierlein<br>OJ Wick | 8/28 - 9/15 | Geneva, Switzerland | US Delegate to the 2nd Geneva Conference - present papers | HC Paxton | No |

## VISITS TO OTHER INSTALLATIONS (CONT)

| Name | Dates of Visit | Company Visited and Address | Reason for Visit | Personnel Contacted | Access to Restricted Data |
|---|---|---|---|---|---|
| JW Riches | 8/4 | Mallory Sharon Metals, Niles, Ohio | Fabrication of zirconium | GB Brown | No |
| | 8/5 | Chase Brass & Copper, Waterbury, Conn. | " | DK Crampton | " |
| | 8/6 | Tube Reducing Corp., Wallington, N.Y. | " | CL McGargle | " |
| | 8/7 | Allegheny Ludlum Steel, Watervliet, N.Y. | " | RE Rohrabaugh | " |
| | 8/8 | Superior Tube Co., Norristown, Pa. | " | HW Cooper | " |
| | 8/11 | Curtiss Wright, Buffalo, N.Y. | " | CK Iwashita | " |
| | 8/12 | New Rochelle Tool Co., New Rochelle, N.Y. | " | CA Tudbury | " |
| | 8/13 | Hunter Douglas Corp., Riverside, Calif. | " | RA Quadt | " |
| | 8/14 | Harvey Aluminum Torrance, Calif. | " | GA Moudry | " |
| RC Aungst | 8/11-14 & 8/27 | New Rochelle Tool Co., New Rochelle, N.Y. | " | CA Tudbury | " |
| | 8/15 | Nuclear Metals, Inc., Cambridge, Mass. | " | TA Tarpey | " |
| | 8/26 | Carpenter Steel, Union, N.J. | " | B Brady | " |
| | 8/28 | Wolverine Tube Co., Detroit, Mich. | " | EA Wright | " |
| HP Oakes | 8/26 | Carpenter Steel, Union, N.Y. | " | B Brady | " |
| | 8/27 | New Rochelle Tool Co., New Rochelle, N.Y. | " | CA Tudbury | " |
| | 8/28 | Wolverine Tube Co., Detroit, Mich. | " | EA Wright | " |

## VISITS TO OTHER INSTALLATIONS (CONT)

| Name | Dates of Visit | Company Visited and Address | Reason for Visit | Personnel Contacted | Access to Restricted Data |
|---|---|---|---|---|---|
| RW Stewart | 8/9-10 | Dow Chemical Co., Boulder, Colo. | Quail Program | IB Venable | Yes |
| JH Rector | 8/12-15 | Monarch Machine Tool Co., Sheffield Gage Co., Sidney, Ohio | Demonstration on machining and gaging | A Killihan | " |
| TD Chikalla | 8/13-14 | Kux Machine Co., Chicago | Die casting problems | JJ Kux | No |
| RD Nelson | 8/18-26 | Los Alamos Scien. Lab., Los Alamos, N.M. | Transformation kinetics of plutonium | JS Foster | Yes |
| | | UCRL, Livermore, Calif. | Whitney Project | WJ Ramsey | " |
| HR Gardner | 8/18-19 | LASL, Los Alamos, N.M. | Physical metallurgy of Pu | JS Foster | " |
| RW Stewart | 8/19-31 | Tube Reducing Co., & Allegheny Ludlum, Newark, N.J. | Fabrication of fuel elements | E Fisher<br>Mr. Vandermark | No<br>" |
| WB Weihermiller<br>TC Nelson | 8/25-29 | Phillips Pet. Co., Idaho Falls, Ida. | MTR Program | MH Bartz | Yes |

## VISITS TO HANFORD WORKS

| Name | Dates of Visit | Company & Address | Reason for Visit | HW Personnel Contacted | Access to Restricted Data | Areas & Bldgs. Visited |
|---|---|---|---|---|---|---|
| MJ Sinnott | 8/1-6 | U. of Michigan, Ann Arbor, Mich. | Consultant Agreement 169 | FW Albaugh<br>JJ Cadwell<br>EA Evans<br>SH Bush<br>OJ Wick | Yes | 300, 328, 326, 325, 303<br>200 W, 231, 2704Z |
| G Utting | 8/7-8 | Technical Meas., New Haven, Conn. | Troubleshooting on 100-channel analyzer | RG Clark | No | 300, 326 |

## VISITS TO HANFORD WORKS (CONT)

| Name | Dates of Visit | Company & Address | Reason for Visit | HW Personnel Contacted | Access to Restricted Data | Areas & Bldgs. Visited |
|---|---|---|---|---|---|---|
| FA Geraldsen | 8/4-27 | GE-ANPD, Idaho Falls, Ida. | Thermal stress cycling tests | JM Batch | Yes | 100D, 1707, 189 300, 3702 |
| EF Thurston<br>JD Provost | 8/14-16<br>8/20-21 | Same as above<br>" " " | | | | |
| W Brown | 8/4-5 | Canadian GE Co., Peterborough, Ont. | PRTR & NPD-2 design & development | H Harty<br>RH Purcell<br>JM Batch | No<br>"<br>" | 700, 713<br>300, 314<br>100-D, 1707, 189 |
| CD Vail | 8/1 | Minneapolis-Honeywell, Seattle, Wn. | Service potentiometers | DR Green | " | 300, 326 |
| JC Bowman<br>WP Eatherly<br>PJ Hastings<br>RL Mansfield | 8/18-19 | Natl. Carbon Co., Research Lab., Cleveland, Ohio<br>Natl. Carbon Co., Niagara Falls, N.Y. | Radiation effects in graphite | RE Nightingale<br>EM Woodruff<br>JM Davidson<br>DE Baker<br>HH Yoshikawa | Yes<br>" | 300, 326, 3730<br>100-K, 105-KE<br>200-E, 2101 |
| WT Elston<br>M Redmount | 8/27-28 | Speer Carbon Co., St. Marys, Pa. | Radiation effects in graphite | RE Nightingale<br>EM Woodruff | Yes | 300, 326, 3730, 305<br>200-E, 2101 |
| WE Harvey | 8/26 | Crescent Carbon Co., Lancaster, Calif. | Reactor grade graphite | RE Nightingale<br>EM Woodruff | No | 700, 703 |
| GH Wilson | 8/26 | E.S. Gilmore Co., Tacoma, Wn. | " " " | " | " | " |
| HC Schweinler | 8/25 | ORNL, Oak Ridge, Tenn. | Theories of radiation damage | HH Yoshikawa | No | 300, 326, 3760 |

VISITS TO HANFORD WORKS (CONT)

| Name | Dates of Visit | Company & Address | Reason for Visit | HW Personnel Contacted | Access to Restricted Data | Areas & Bldgs. Visited |
|---|---|---|---|---|---|---|
| JT Ewing<br>R Waldron<br>L Germain | 8/1 | UCRL, Livermore, Calif. | Whitney Project | OJ Wick<br>RW Stewart | Yes | 200-W, 231, 2704-Z |
| JT Ewing | 8/5-8 | Same as above. | | | | |
| MH Bartz<br>J Simmons | 8/6 | Phillips Pet. Co., Idaho Falls, Ida. | MTR fuel elements | OJ Wick<br>TC Nelson | Yes | 200-W, 231, |

238480

# PLUTONIUM RECYCLE PROGRAM

## MONTHLY REPORT - AUGUST 1958

## REACTOR & FUELS RESEARCH & DEVELOPMENT OPERATION

### Plutonium Fuels Development

Al-Pu Capsules for MTR Irradiation (GEH-3-33 through 40). The Al - 5, 10, 15 and 20 w/o Pu and Al - 12 w/o Si - 5, 10, 15 and 20 w/o Pu alloy cores for the capsules to be irradiated in the MTR under tests GEH-3-33 through 40 have been cast, sampled, and machined. Analytical results have not been received yet on the AlSi - 20 w/o Pu alloy samples. The Zircaloy jacketing components are being welded and radiographed. The alloy cores will be given an annealing treatment prior to final dimensional inspection and assembly.

Al-Pu Alloy Clusters for KER Irradiation. The first four-rod cluster of Zircaloy clad Al-Pu has been charged into the KER loop facility and is operating satisfactorily. The second four-rod cluster containing Al - 8 w/o Pu and Al - 12 w/o Si - 8 w/o Pu alloy cores, which is to be irradiated in the KER loop facility under Production Test IP 186 A, was delivered to KE Reactor on August 15, 1958, as scheduled. This cluster constituted one portion of the current standby charge for Loop 1 and will be charged during the first quarter of 1959.

$PuO_2$-$UO_2$ Mixed Crystal Oxide Capsules for MTR Irradiation (GEH-3-43,44). Flux depression calculations have been completed for the $PuO_2$-$UO_2$ mixed crystal oxide capsules which are to have the concentration of Pu adjusted so that the capsule is equivalent, from a heat generation standpoint, to a similar size capsule of Al - 1.8, 5, 10, 15 and 20 w/o Pu alloy. Fuel material densities of 90 and 70 percent of theoretical values were considered. For instance, it was calculated that a mixed crystal oxide whose density was 70 percent of theoretical and the composition of which was natural $UO_2$ - 0.187 w/o $PuO_2$ is equivalent from a heat generation standpoint to an Al - 1.8 w/o Pu alloy of similar size. Also, it was calculated that a mixed crystal oxide whose density was 90 percent of theoretical and the composition of which was $UO_2$ - 0.0259 w/o $PuO_2$ is equivalent from a heat generation standpoint to an Al - 1.8 w/o Pu alloy of similar size. The flux in the center of the 70 percent dense oxide is 96 percent of the flux on the surface and the flux in the center of the 90 percent dense oxide is 95 percent of the flux on the surface.

Sheathing for Plutonium Fuel Element Development Studies. The initial 600 feet of the order for Zircaloy-2 tubing for 19-rod cluster fabrication for PRTR loading is tentatively scheduled for delivery during the latter part of September 1958.

An order for 400 feet of 304 alloy, thin wall (0.008-inch thickness) stainless steel tubing, scheduled for shipment on August 20, 1958, has not yet been received. A request was issued to procure 400 feet of 304L alloy stainless steel tubing of 0.005-inch wall thickness. This tubing is to be fabricated from vacuum-melted stock.

Die Casting. The detailed design of a tube holding block adaptable to a 400-ton die casting machine is being made by the Kux Machine Company. To conserve on time, fabrication of components will begin when the design is completed; however, final machining will await PMO design approval.

An aluminum-uranium alloy was cast into 0.020" wall Zircaloy with the present prototype equipment. The tubing had been pickled and vacuum annealed at 800 C for one hour and stored in an argon atmosphere prior to casting. The 775 C melt was vacuum die cast at 1600 psi to a density of 93.5 percent of theoretical. Radiographs showed considerable centerline shrinkage, but good adherence between tubing and casting. This density is an increase of 2.5 percent over a casting into Zircaloy which had not been outgassed.

Air Pressure Injection Casting. A method was developed for fabricating Al-Pu irradiation capsules by injection casting. A capsule was made with fusion welded end closures that were free of contamination. Another capsule that was [illegible] for pile charging was found to have gross Pu segregation. This experiment will be repeated to produce injection cast Al-Pu capsules for irradiation testing.

Installation is nearly complete for the glove box injection casting equipment. This equipment should be ready for trial runs next month. "Cold" experiments are planned to evaluate the apparatus before going "hot".

Extrusion. The 280-ton extrusion press was completed and preliminary experiments have commenced. Wrought 1100 and 6063 aluminum billets were extruded into 1/2-inch diameter rods over 20 feet long. Previously developed die design and lubrication techniques were used. All components of the hydraulic system functioned properly. The ratio of die throat bore and extrusion diameter appeared to be markedly temperature dependent. Experiments are currently under way to obtain a die throat diameter value for this temperature dependence.

Welding Development. Closures on injection cast, Al-Pu bearing fuel rods have been successfully accomplished. Requirements for non-contaminated welds are that all of the Al-Pu core material be machined away from the weld zone.

An extension tube is being installed on the vacuum welding box to permit end cap closures on full length 19-rod cluster elements.

19-Rod Fuel Element Cluster Engineering. A full size stainless steel-clad, aluminum-cored, 19-rod cluster has been fabricated for hydraulic pressure drop and thermal cycle tests. Before this cluster is delivered for testing, two Zircaloy clad and Zircaloy wire wrapped rods will be substituted for the corresponding stainless steel rods in the cluster. One rod will be placed in the six-rod ring and the other in the 12-rod ring. These tests will be the first conducted at Hanford on an eight-foot Zircaloy-2 wire wrapped and clad element. The date of final assembly of this cluster is dependent upon the completion of etching facilities which are necessary before the rods can be autoclaved.

Another item to be tested will be the compression bands around the circumference of the cluster. The purpose of the bands is to compress and hold the rods together until all adjoining rods and wires are in contact. The types of bands

will be tested, one 1/8-inch wide and another 3/16-inch wide. Both size bands are made from 10-mil thick stainless steel. The thickest part of the band, which has two wraps around the cluster, is over the buckle. This measures 70 mils and is within the outer limits of the wire wraps. An air tool has been adapted to apply a pre-set tightening force on the bands and different loads will be applied on the two types to determine which is the proper one.

Facilities

A machine which will disassemble an irradiated 19-rod cluster for inspection and reassemble it for a return cycle in the PRTR is being scoped. This machine will be located in the fuel element inspection cell.

The design of the rod straightening machine hood and modifications are 90% complete.

The 50 kw motor generator set has been tested. The following equipment has been accepted from Minor Construction: mold preparation hood, canning hood, autoclave hood, extrusion press, and electrical work on cryolite system.

A design was completed for a vacuum annealing furnace capable of heating ten eight-foot long Zircaloy tubes to 700 C in a vacuum of less than 0.1 micron. This furnace, when fabricated, will be used to vacuum outgas Zircaloy tubing prior to injection casting.

$UO_2$ Fuel Development

Irradiation of Swaged $UO_2$ Fuel Elements. In-reactor tests of fuel elements containing $UO_2$ powder compacted by swaging are being conducted to determine: (1) the irradiation behavior of swaged $UO_2$, (2) the accuracy of core temperature predictions, and (3) the dimensional stability. Four-rod cluster fuel assemblies were inserted in KER loops 1 and 3, during the outage of August 4, 1958, for irradiation to 1000-2000 MWD/T. These clusters represent 528 inches of 0.625 OD swaged $UO_2$ fuel rods fabricated with natural and with 1.6 w/o enriched $UO_2$ swaged to densities which were 81 to 89% of the theoretical. Stainless steel and Zircaloy-2 were used to clad the $UO_2$ powders. Also under irradiation, in a production process tube in another reactor, is a three-foot long, stainless steel clad, swaged $UO_2$ fuel element. Approximately half of the requested burnup has been completed without incident. Two swaged capsules with natural $UO_2$ and three with 2.44% enriched $UO_2$ also are being irradiated as part of a program to determine the stability of swaged $UO_2$ elements operating with extremely high core temperatures and to long exposures. Two additional capsules are under irradiation in the ETR at a reported flux of approximately $1.4 \times 10^{14}$.

Irradiation of Tubular Fuel Elements. Uranium dioxide (8% U-235) rings, (2.310" OD x 1.786" ID) and pellets 0.5" diameter, were fabricated for a six-foot tubular fuel element to be irradiated next month in SRE, as part of a joint HAPO-AI program. The oxide was fabricated by the conventional techniques of pressing, sintering and grinding. Fabrication of fuel for a second six-foot SRE assembly is under way. Included are three feet of conventional core (2.310" OD x 1.786" ID) and three feet of 1/2-inch thick rings of the same diameter, but with each ring accurately drilled with six 0.33" thermocouple holes.

Swaged $UO_2$ Fabrication. Fabrication of nine swaged $UO_2$ (2.42% U-235) fuel rods for irradiation in the VBWR is complete except for autoclave testing. The $UO_2$ in these fuel rods compacted to 87.5 ± 0.5% of the theoretical density. Fuel rods also were swaged for four seven-rod clusters to be irradiated in the KER loops. Various $UO_2$ powders were used in these rods, to obtain densities of 84 to 90% of the theoretical. A special "high-fired" $UO_2$ powder from ORNL also was investigated. The densities achieved in swaging this material were 1-2% less than those obtained with $UO_2$ powders prepared at Hanford.

$UO_2$ for Swaging. Pyrophoric 2.42% enriched $UO_2$ having a surface area of 7 $m^2/g$ was converted to massive sintered $UO_2$ having a density 95.5% of the theoretical. This was accomplished by sealing the $UO_2$ into rubber tubes which were then isostatically pressed. The large compacts were then sintered in hydrogen to obtain pieces of dense $UO_2$ which could be crushed and sized to obtain material for swaging fuel rods for irradiation in the VBWR.

High Density $UO_2$ Powder. Ammonium diuranate was evaluated as a source of high density powder for swaging. Sintering of loose ammonium diuranate powder to obtain $UO_2$ apparently has no advantages, inasmuch as sintering temperatures of approximately 1700 C were required. Sintering of cold pressed ammonium diuranate compacts is still being investigated.

High Temperature Irradiation Studies. The behavior of ceramic fuel materials under extreme irradiation temperatures is being studied. Four elements consisting of loose-unsintered, enriched $UO_2$ in Zr-3 cans, six inches long and one inch OD were irradiated and are now being examined. Preliminary observations are summarized below.

1. The $UO_2$ powder was redistributed to one end of each of the elements.

2. The redistribution occurred during the initial part of the irradiation and remained in the same position during the entire cycle.

3. The powder in one element in each of the two irradiations relocated vertically to the top of the can. Powder in the other element in each test was relocated to the bottom.

4. The columnar grains surrounding the molten center consist of large crystals of $UO_2$. The $UO_2$ outside the tubular crack, approximately 2/3 of the radius from the center, exhibits a microstructure vastly different from the columnar grains, i.e., smaller crystals, larger voids, and an unusual microstructure within the grains.

5. The high molar percentage, 63%, of hydrogen accompanying the released gaseous fission products has been attributed to the release of hydrogen adsorbed during the reduction step in preparing the $UO_2$ powder for irradiation.

Facilities. The Sciaky seam welder was checked out and operated satisfactorily by the vendor's representative. The large sintering furnace also was checked at low temperature by a vendor's representative. The operability and circuitry

were found to be generally satisfactory, although several minor modifications to the electrical wiring are required. The evacuable, inert atmosphere welding glove box could not be evacuated to the requiredpressure, principally because octyl alcohol had been used by the Minor Construction contractor to clean up the piping. The unit has been dismantled for a thorough clean-up. A monorail and switches for an overhead system for conveying the PRTR fuel element to the several assembly stations were procured from excess.

Corrosion Studies

PRTR Steel Shot Corrosion Tests. The PRTR top and bottom shields are to employ steel shot, cooled by softened water. Previous tests showed excessive corrosion of five kinds of shot in softened water, the voids around the shot becoming plugged with rust. Hence, a program was started to evaluate corrosion inhibitors in this service. Filming amines and raising the pH with sodium hydroxide were considered.

The filming amines tested so far, Corban 207 and Kontrol 12, were worse than useless in the service, as measured by loss of flow capacity of the shot. Other amines are being tested. However, the usual condition for success with filming amines is complete exclusion of oxygen. Oxygen will not be excluded in the PRTR shield and is not excluded in the test apparatus. Hence, success with filming amines is not likely in this system.

The first test on sodium hydroxide as a corrosion inhibitor failed, though there was little evidence of corrosion. An improper regeneration cycle on the water softener allowed calcium to get past the softener. This calcium was precipitated as the carbonate by the sodium hydroxide addition. The calcium carbonate completely plugged the system, though there was little evidence of rusting. A new test is under way with better control of the water softener. This technique is expected to control the corrosion, though the Na-24 radioactivity problem remains.

Corrosion resistant shot would be more satisfactory than inhibitor systems. Design Development Operation is procuring shot of Duriron (14% Si) composition, which are expected to be entirely resistant under these conditions.

PRTR Component Testing

Hammel-Dahl and Powell control valves have run over 200 hours on ELMO-7 for leak testing at 535 F, 1300 psi. The Powell valve began leaking immediately after startup, averaging 0.3 ml/min leakage. It was inspected at the next loop shutdown, the packing tightened, and the leakage stopped. The Hammel-Dahl valve began leaking after 30 hours with an average of 0.02 ml/min leakage. The packing was not tightened during shutdown and the leak rate increased to 1.3 ml/min upon loop startup.

An inlet fitting using an 18-thread per inch Parker tubing connection on one end and a 12-thread per inch fitting on the other began leaking on the 18-thread per inch end after loop startup. The section ran a total of 100 thermal cycles between 300 and 490 F. In one four-hour check period, the 18 tpi end lost 15 ml/hr and the 12 tpi end lost 12 ml/hr. Neither end leaked during 60 hours testing at

a steady state 535 F temperature. A PRTR resistance temperature detector using a strap-on design was tested to determine response time and accuracy. Preliminary results show a fairly good response rate with about a 25 F difference between the internal fluid temperature and the strap-on RTD.

Zirconium Tubing

With the completion of a development order with Damascus Tube Company, all sizes of Zircaloy tubing have been produced for the nested tubular fuel element. As a result of various development orders, several vendors are now in a position to bid competitively on the fabrication of such tubing on a guaranteed product basis. Progress was made toward the production of externally ribbed tubing for the nested tubular fuel element by both Nuclear Metals and New Rochelle Tool Company. Several techniques were employed by Nuclear Metals to obtain final dimensions for their extruded ribbed tubing. At New Rochelle Tool Company the basic features of the welding machine have been completed, and tests are being performed to debut the mechanical and electrcial features of the unit. Test welds were made using a series of conditions and are being evaluated to permit the vendor to produce initial sample tubes for acceptance testing.

A development lot of Zircaloy-2 tubing for the swaged oxide element was received from Wolverine Tube Company. Preliminary swaging tests by Ceramic Fuels were encouraging; consequently, Wolverine is proceeding with a production size order. A production order of tubing for 19-rod cluster fuel elements for plutonium-bearing fuels was placed with Wolverine, with promised delivery of the initial quantity of tubing in late September. Wolverine is currently well along toward completing the fabrication of this tubing.

Bids were received for the fabrication of 100 Zircaloy-2, PRTR process tubes. Although several fabricators are willing to undertake the job of producing this tubing, none were completely responsive to the terms and conditions of the inquiry. Direct negotiation for the fabrication of this tubing was initiated with the Tube Reducing Corporation for approximately 100 tubes, and with Hunter Douglas Aluminum Company for approximately 30 tubes. The process proposed by Tube Reducing has been developed over the past year and a half in cooperation with Chase Brass and Copper Company and Allegheny Ludlum Steel Corporation. A new fabricating process employing cold precision extrusion was proposed by Hunter Douglas Aluminum Company.

Radiometallurgy Laboratory Studies

Radiometallurgy activities in support of the 4000 Program included a continuation of the examination of Zr-3 clad, $UO_2$ fuel elements and the collection of 32.5 mm of gas (STP) from one of the capsules. The results and conclusions of the above work are reported in more detail in connection with the respective development programs involved.

Thermay Hydraulics Studies

Experimental Results. A short report has been prepared concerning the hydraulic characteristics of the 19-rod PRTR fuel element. Experimental data with light water at 66 F indicate that pressure drops along the fuel element is described

satisfactorily by the hydraulic radius concept. For example, at 100 gpm the calculated pressure drop is 0.85 psi/ft whereas a value of 0.88 was experimentally determined. Since the effect of the spiral wires was ignored with the exception of area considerations, this agreement between theory and experiment is considered to be exceptional.

A new group of experiments were conducted to help determine the response time of the proposed 0 to 25 psi ($\Delta P$) PRTR flow monitors. The specific purpose of these tests was to determine the time base from which to measure the trip response time of the flow monitors. Offner High-speed recorders were used to record travel of a quick-closing valve, flow rate (indicated by a Potter turbine-type flow meter), absolute pressure downstream of the quick-closing valve, differential pressure across a venturi, and relay trip of the proposed PRTR flow monitors. These tests showed that the $\Delta P$ as seen by the flow monitor and the actual flow rate do not drop appreciably until about 0.3 of a second after the quick-closing valve has closed to the 60 percent flow position. Basing the flow monitor trip response time on this new time zero, the flow monitors now have a trip response time of about 0.3 second for a 40 percent flow reduction. This is much more satisfactory than the 0.6 to 0.7 second response previously reported.

PRTR Calculations. Further work has been done on the problem of the air cooling of the Mark I and Mark II B fuel elements for the PRTR reactor during optical examination. A program of experimental work requiring a minimum amount of new equipment has been outlined.

A study has been made of the effect of temperature and pressure on the solubility of helium in heavy water. Solubility data for helium in heavy water have been presented graphically in a form such that one can follow pressure-temperature transients during reactor operation and read off directly values for helium solubility. The release of helium during normal operation and during a scram with power failure have been computed. The effect of this release on the reactor operation has been considered.

## Mechanical Equipment Development

Design Test PR-20 - Calandria Characteristics. The prototypical dump valves were installed in the calandria mockup and are now being altered to meet required response time. The mockup flow system is being changed from single pass to recirculation for the moderator level control tests. A testing priority was established for the mockup as follows: (1) Moderator Flow Distribution Tests, (2) Moderator Level Control Tests, and (3) Moderator Dump Tests.

Design Test PR-24 - Shroud Tube Bellows. The Solar Aircraft Company has developed a satisfactory method of brazing the aluminum ends to the stainless steel bellows. The stainless steel ends of the bellows are titanium plated before the brazing process. These bellows will be tested after receipt. Shipment of the Solar aluminum bellows for testing is also expected in September.

After being flexed 12,000 times, the bellows from the Masters Products Company were installed on the hot steam corrosion test apparatus. The gas leak rates of these bellows were 4-1/2 cubic feet/hour at room temperature and 3/4 cubic foot/hour at 600 F.

The bellows furnished by the U. S. Flexible Metallic Tubing Company broke after 1500 cycles on the flexure tester. Additional bellows have been ordered from the Parts Engineering Company.

Design Test PR-25 - Shroud Tube Collapsing Pressures and Installation. The final report, HW-57089, will be issued early in September.

Design Test PR-32 - Biological Shield Moat Reupture Diaphragm. Tests conducted using a 4.9-mil thick aluminum membrane revealed rupture pressures of 3-1/2 psi. This value is approximately one-half the calculated and desired value. Additional tests were run with membranes made with two thicknesses of 4.9-mil foil. The rupture pressures were about seven psi. Future tests will be conducted using a membrane with a single thickness of eight to ten-mil aluminum foil.

Design Test PR-50 - Reactor Piping Seal Testing. The flanged process tube inlet fitting utilizing a solid "O" ring has undergone 750 temperature cycles without noticeable leakage. A similar fitting using a flexitallic gasket has been thermocycled 1050 times without noticeable leakage. The solid copper "O" ring was replaced on the inlet gas seal assembly. The new gasket shows a similar leakage pattern, with the greatest leakage during the rapid cool-down portion of the cycle.

The housing of Nozzle cap assembly "A" has been modified to provide a smaller clearance around the flexitallic gaskets and to permit testing of two different sizes of gaskets. The fitting has undergone 225 temperature cycles without any leakage.

Process tube assembly "A" has been thermocycled 750 times without leakage. Process tube assembly "B", utilizing "conseal"joints, was hydrostatically tested and will be thermocycled. Process tube assembly "C" is being fabricated, using "as designed" components.

Two packings were tested in the outlet gas seal tester. Both the John-Manville Type MX4439 and John Crane Type 177AI were rejected due to high gas leak rates.

Design Test PR-51 - Reactor Piping Structural Integrity. The mockup of the lower face is now 90 percent complete. Fabrication of the upper face mockup and outlet jumpers for flexure testing continued.

Design Test PR-63 - Process Channel Leak Detection Facility. All experimental work has been completed. The minimum leak detected was one drop per five minutes. The maximum leak rate before the vapor spreads to an adjacent process channel was eight drops per minute when injected two feet above the upper bellows, 15 drops per minute six inches above the bellows, and eight milliliters per minute six inches below the bellows.

Single Tube Prototype Facility. Construction of Phase I is practically complete with the exception of the installation of the pump. The pump should be shipped by October 1. Installation of the full size process tube assembly has begun.

PRTR Inlet Valves. The 1-1/2-inch valves leaked considerably during the first operating period on ELMO-7. Following adjustment of the packing glands, there has been no measurable leakage.

Aldrich Injection Pump. The pump has operated for a total of 21 hours. Flow calibration tests revealed a flow of 17.4 gpm at a discharge pressure of 10 psi and a flow of 16.3 gpm at a discharge pressure of 1200 psi.

Test Shaft. Movement of the tube rupture facility was completed.

Seal Test Facility. Start-up of this facility was delayed for the installation of suitable thrust bearings on the mechanical seal shafts.

Charge-Discharge Machine Study. A study report was received from Construction Engineering Operation on possible sites for the testing of the entire machine. The order of preference was PRTR Reactor Hall, 189-F Building, and 314 Building. A study has begun on the advisability of testing the machine without the main carriage.

Shielding Studies

PRP Shielding. The review of PRP shielding was continued. The shield thickness for the compartment over the steam generator was calculated, and dose rates through the vertical cast iron shielding for the fuel element examination facility have been computed.

PRTR Instrumentation. The initial static and flow checks have been completed on all prototype flow monitors which have been received. A summary report is being prepared. All units will be checked next on an accelerated life test.

One of the first two wrap-on prototype resistance temperature detectors furnished by Aero-Research has received 1000 thermal cycles for a life test. Two new Aero-Research prototypes have been received. Three strap-on units have been received from Charles Engelhard, Inc., and are still undergoing tests. The low resistance from sensor to ground has been corrected. One unit has completed 250 thermal cycles. A second instrument was mounted on the KER loop for response tests, and the results indicate that the response is satisfactory. The third unit has failed.

The rough draft on an 85-point power calculator has been submitted for comment.

PRTR Design Development

Construction Status. The Phase I PRTR contract is estimated to be about 15 percent completed versus 25 percent scheduled. The bottom portion of the containment vessel has been lowered onto the concrete pedestal after inspection and membrane placement. The knuckle plates and the next higher course of steel plates have been welded to the ellipsoidal portion of the shell.

The lack of contact noted between the containment shell and the concrete pedestal, when the former was lowered into place, is being resolved by pressure grouting between the surfaces. The vessel bottom will be "sounded" to detect void spaces, which will be filled by drilling through the shell and pumping in grout.

The Phase II PRTR contract is estimated to be about five percent completed and is within schedule. The contractor has completed the well drilling operation and has poured some of the service building footings. The acceptance test on the well was completed satisfactorily. A flow of 750 gpm was pumped for about eight hours with little change in water table level.

Design Status. The Phase II-A PRTR design and specifications were completed. This contract will include the river pump structure and condenser structure.

The Phase III PRTR design and specifications were completed on schedule. It is anticipated that the bid assembly will be forwarded to the AEC on September 2. The contract is scheduled for award about November 1. It is the last major construction phase for the PRTR.

Process Tubes. No bids were received in compliance with provisions of the purchase order. It will be necessary to negotiate a contract for procurement of the tubes.

Fuel Transfer System. The control panel and electrical design for the fuel transfer system are complete; modifications to make the water pit conveyor removable have been completed.

Design drawings of the fueling vehicle were completed by General Mills during the month and forwarded for review. A brief assembly procedure and some reproducible drawings were received for inclusion in the Phase III bid package.

Process Piping. An order was placed for fabrication of a blowdown flash tank for the steam generator. An order for fabrication of a boiler feedwater preheater-deaerator was placed.

Fuel Element Examination Facility. The project proposal revision to include the Fuel Element Examination Facility as part of the PRTR project (AEC-167) has received the required GE and AEC approvals. The final draft of the design criteria is being prepared for issuance.

Instrumentation and Control. Minneapolis-Honeywell is proceeding with their design and analysis of the PRTR automatic controller. The moderator level dynamics and neutron kinetics simulations developed here have been set up on their analog facility along with a simulated control system. This simulation is being used to develop the optimum controller design parameters. Frequency response runs have been requested by Minneapolis-Honeywell on a PRTR loading in which 50% of the fissions occur in plutonium. This loading, which has a total delayed fraction of 0.00541, corresponds to the maximum plutonium enrichment considered in the latest PRTR Safeguards Analysis. Actually, much lower enrichments are expected but the automatic controller, while designed for the actual loadings expected, will be capable of handling this loading also as a "worst expected control case".

The final design of the automatic controller is expected by the vendor to be complete in October, with delivery about July 1, 1959.

PRTR Physics. The three group VALPROD study of the reactivity value of spike plutonium loading configurations has been completed for fresh and 25% burned out plutonium for both a $D_2O$ and $H_2O$ reflector. A limited number of 50% burned out plutonium cases was also investigated. As was pointed out previously, the power distribution associated with the cases may not be acceptable even though the critical condition is satisfied. Therefore, calculation of peak to average power ratios and tube powers for each case is currently under way. An IBM-650 program has been written which takes the power distribution output of VALPROD and computes maximum to average power ratio, power per tube, and peak powers for each tube. Computing time is 1.5 minutes per case. A comprehensive report is being prepared on this work.

A calculation of the maximum rate of reactivity gain due to burnout of Xe-135 caused by a startup at peak poisoning has been made. It was found that the rate would not exceed 0.8 mk per minute, and is, therefore, easily controllable.

Flux traverses in mixed crystal oxide ($UO_2$-$PuO_2$) samples to be irradiated in the MTR as part of the Plutonium Fuel Development Irradiation Test Program have been calculated. Calculation was performed utilizing the IBM-659 P-3 code. The samples are to be equivalent in heat generation to 1.8, 5, 10, 15 and 20% by weight plutonium in Pu-Al alloy. Further calculations on samples with other plutonium carriers are planned.

Pressurized Gas Cooled Loop Facility. A project proposal for a Pressurized Gas Cooled Loop Facility was written. The proposed facility, to be installed in the PRTR, will contain two similar test sections, one located in the reactor and one in the experimental cell. The cost for the installed facility was estimated at about $500,000.

Plutonium Fabrication Pilot Plant

Over-All Status. Design is 57% completed. Construction is 8% complete.

Design. Phase III design is 40% completed. Scope revisions changed the location of the vacuum welding box and revised the list of Group 5 relocated items to include a hooded centerless grinder, six-inch rolling mill and furnaces, two rod straighteners, small extrusion press and hood, outgassing furnace, cryolite reduction furnace, and drawbench.

The rolling mill and extrusion press will be designed for hooded operation but initially installed without hoods.

Cost estimates are being obtained to evaluate the desirability of gas cooling, rather than water cooling, for the 30 kw melting furnace.

Hood control system tests have been started.

Construction. The tunnel cover slab was poured, and all column footings have been poured to level 0-0. Pouring of the degrease and autoclave pit walls is complete.

Procurement. The swaging machine has been received and is being tested by Plutonium Metallurgy Operation.

The SKLO Electric Company was instructed August 15 to proceed with installation of the door alarm system.

Requisitions were processed for the 200-ton hydraulic press and hood, fuel rod preparation lathe, and oxide preparation line process hoods.

F. W. Albaugh

Manager, Reactor and Fuels Research
and Development

# PHYSICS AND INSTRUMENT RESEARCH AND DEVELOPMENT OPERATION

## MONTHLY REPORT

## AUGUST 1958

## FISSIONABLE MATERIALS - 2000 PROGRAM

### METALLURGY

At the request of the AEC a "Guide to Shipment of $U^{235}$ Enriched Uranium Material" was reviewed. This is an Oak Ridge document.

An empirical method was worked out to estimate the critical masses of plutonium shells. The results were used to check the nuclear safety of shipping three rough castings.

### REACTOR

### STUDIES RELATED TO PRESENT PRODUCTION REACTORS

Both theoretical and experimental work was done on the problem of the neutron energy spectrum in the vicinity of a temperature discontinuity in a moderator. Theoretical work included precise evaluation of twenty constants occurring in an analytical solution. Experimental work was done in the PCTR core where foil traverses were taken perpendicular to a hot-cold graphite interface. Considerable difficulty has been experienced in heating the hot region because of heater failures. Cooling a region with liquid nitrogen has been more successful. Partial analysis of one of the experiments indicates good agreement between inferred neutron temperature changes and observed graphite temperature changes. Analysis of the data has not been completed to determine a distance from the hot-cold boundary which characterizes the shift in neutron temperature.

Buckling measurements began to determine relative reactivities of solid and I and E fuel elements in B, D, F type reactors. IPD physicists are interested in getting these measurements for use in reactor safety analyses.

#### Instrumentation

Application work and investigation continued concerning magnetic core storage elements as applied to radioisotope analyzation circuits.

### STUDIES RELATED TO FUTURE PRODUCTION REACTORS

Analysis of buckling measurements was completed on a series of experiments with 7-rod clusters of 0.5-inch-diameter rods. This completes the planned program on these clusters. There is no theory correlating these measurements, so this remains as a fertile field for future work.

Materials are being assembled to measure $k_{\infty}$ of a 7-rod cluster of 0.926-inch-diameter rods in the PCTR. These data will be used to check existing negative buckling measurements obtained with expcnential piles.

STUDIES RELATED TO SEPARATIONS PLANTS

More subcritical neutron multiplication measurements were made on 0.925-inch-diameter uranium rods in light water. The rods were enriched to three percent in $U^{235}$. Two lattice spacings were used. For each spacing, two experiments were done, one with 16-inch-long fuel charges, the other with 24-inch-long charges. The purpose was to measure the effect of experimental geometry on critical mass. From this information, one will be able to better evaluate the effectiveness of the water reflector surrounding the uranium-loaded core. The 16-inch-long fuel charges gave critical mass values lower than the 24-inch charges by about twenty percent.

Work proceeded on the analysis of PCTR data to obtain $k_{\infty}$ of 3% enriched $UO_3/H_2O$ mixtures. Thin sheets of boron containing plastic were received from Phillips Chemical Company. This material will be used as the neutron absorber in future experiments in this series.

At the Oak Ridge Critical Mass Laboratory two loadings were made of 0.95 percent I and E slugs in a mockup of a Hanford dissolver. Twelve tons of metal were loaded randomly by dumping. A neutron multiplication of about three was obtained. From this data ORNL personnel extrapolate a curve of mass versus inverse neutron multiplication to predict a critical mass of at least sixteen tons. In these experiments the slug packed into the tank with a density of 556 pounds of uranium per cubic foot. When compared with Hanford measurements on uniform arrays of fuel elements, the ORNL random arrays give a buckling 30 percent smaller than the Hanford uniform arrays for the same density of uranium. This reduction has been used to calculate a new allowable batch limit for irradiated 0.95 percent I and E slugs in HAPO dissolvers. If one assumes that the irradiated slugs have an effective enrichment of 0.98 percent $U^{235}$ and that the dissolution leads to a lower density of uranium in the dissolver (and hence a more reactive case) then the predicted critical mass drops from 16 tons to 6.3 tons. To apply this to an operational case, one applies a safety factor of 0.9 and divides the result by two to allow for double batching to get a permissible batch limit of 2.8 tons. Thus, as a result of the ORNL experiments to date, the dissolver batch limit can be raised from 1.7 tons to 2.8 tons. More work will be done at ORNL. A uniform array will be taken critical for comparison with Hanford exponential experiments. If more 0.95 percent uranium can be obtained, a random loading will be made critical.

A number of nuclear safety consultations were given this month. Problems reviewed for plutonium metal processing included the safety of an array of plutonium pieces surrounded by depleted uranium, a storage bin problem, and an incinerator problem. Process specifications for critical mass control in Purex Plant were reviewed. Drawings of shipping casks for power reactor fuels were reviewed. Criteria were established for the handling and processing $Np^{237}$. These criteria were made conservative because of the lack of critical mass data on $Np^{237}$.

One run on the neutron age measurement was completed using kerosene moderator.

The permanent magnet on the mass spectrometer was energized and the vacuum system was put into operation successfully.

## REACTOR DEVELOPMENT - 4000 PROGRAM

### Studies Related to the Plutonium Recycle Program

A series of calculations are being made to correlate Hanford reactor parameter measurements on 19-rod $UO_2$ clusters in $D_2O$ with similar measurements and calculations made elsewhere. So far the results are that f values agree well for our nine-inch lattice spacing and agree to about one percent for the eight-inch lattice.

The Litton computer was used to plot concentrations of $U^{235}$, and $U^{238}$, and $Pu^{239}$ as a function of flux-time and local MWD/T.

Work has resumed on the problem of theoretically predicting the thermal neutron flux distribution from a line source in the presence of a cylindrical cavity in an otherwise infinite medium. The purpose of this work is to improve our understanding of the operation of the PCTR. Current effort is on investigating the effect of changes in cavity radius and cavity-source separation on the flux distribution.

Work was continued on the development of a more generalized method for computing lattice diffusion constants. The method involves calculation of transmission and reflection coefficients at the boundaries of the various cylindrical regions making up a lattice cell.

### Instrumentation

Work continued on the profilometer for use with the PRTR fuel elements. This device will measure and record the diameter and warp of the elements. Investigation was continued on a second method of combining the profilometer and a 5-X viewer to do a similar job in a better manner.

## CROSS SECTION PROGRAM

A high resolution measurement was made of the fission cross section of $Am^{241}$ in the vicinity of a resonance at 1.25 ev.

A special sample containing 96 percent $Pu^{241}$ was allocated to Hanford for improved fission cross section measurements on $Pu^{241}$. Fission foils are being prepared from this material.

Installation and preliminary tests have been completed on the control units and data recording system for the new KE neutron spectrometer. The spectrometer has been programmed to study the neutron scattering of vanadium. From this will be obtained a calibration of the analyzing crystal and detector used to measure the energy of scattered neutrons.

Both spectrometers were operated inefficiently during the month because of contamination problems not arising from the spectrometers.

## BIOLOGY AND MEDICINE - 6000 PROGRAM

### ENVIRONMENTAL STUDIES

#### Atmospheric Physics

Four field experiments designed to measure the crosswind distribution of concentration of a tracer material at ground level and at distances up to 800 meters from a ground source were attempted. Three of these were successful while the fourth failed completely due to nonfavorable meteorological conditions.

These experiments simulated the conditions which are to be tested extensively next summer. Prototype field samplers and the zinc sulfide counter were tested and a field test of sampler density and loadings to be expected were also completed. Design criteria for the samplers were relatively well established but some further testing of equipment, particularly uniformity of filter thickness, was shown to be necessary.

Field testing of the zinc sulfide particle counter developed by the Instrument Research and Development Operation has shown the instrument to be subject to frequent failure of electronic components. Comparisons of visual readings of filters loaded with zinc sulfide and readings obtained from this instrument have also shown an undesirably large scatter of points, or contingent uncertainties. These have been ascribed to irregularities in filter thickness (the particles are irradiated by $\alpha$ particles through the filter in the counter) and to nonhomogeneous particle size distributions. Efforts have been made to obtain more uniform filters and recent inquiries have shown that special pigments with desirably small particle size ranges have been developed. Close liaison with Instrument Research and Development to complete the development of this particle counter is being maintained.

### DOSIMETRY

The large proportional counter with a window of mylar cemented to a stainless steel grid appeared to be pressure tight over several weeks. A slow decrease was observed in pulse heights from the counter. The decrease is attributed to outgassing of the mylar or cement or to absorption of the counting gas. A small side window proportional counter was made for testing krypton gas fillings and for possible use in detecting plutonium in wounds. An end-window counter is also being made for the latter purpose. Energy calibrations of these counters are being made with a fluorescent X-ray source excited by plutonium X-rays.

The study of detection of uranium in the lungs resulted in better techniques and better calibration. The subject mentioned in the June report was recounted. The result was 7.6 $\pm$ 20 mg uranium in the lung. Only a small part of the uncertainty limit resulted from counting statistics. Most of it resulted from lack of knowledge of the normal background to be expected from plant employees.

The positive ion Van de Graaff was not operated during the month in order to permit installation of a new analyzing chamber and magnet pole pieces.

A review was made of the available information regarding factors for calculating neutron dose rate from neutron flux. Recommendations regarding the best values for different situations at HAPO were prepared for forwarding to Radiation Protection Operation.

Electron beam calorimetry was used to measure the electron Van de Graaff beam power. The result was checked against the value obtained from beam current integration and voltages measured with the new condenser divider system. The agreement between the two methods was 0.2%, although the uncertainties in the measurements were larger than this. This cross checking is our way of reaching the precision of measurement needed for electron beam measurements.

INSTRUMENTATION

Fabrication work continued on the transistorized circuitry for the scintillation alpha, beta, gamma hand and shoe counter.

The scintillation transistorized alpha (only) hand counter has been in constant use as a demonstration instrument at Purex for one month. The same counter was previously used for five months in the 329 Building. No maintenance work has, as yet, been necessary in either case. The instrument will detect and indicate above warning levels for a one hundred d/m $Pu^{239}$ source distributed over a 4" x 8" area. This instrument will eventually replace the presently used "Four Folds."

The vacuum tube model combination alpha, beta, gamma hand and shoe counter is still in constant satisfactory use in the 329 Building.

The portable transistorized combination alpha, beta, gamma instrument was further tested and demonstrated during the month. This one instrument can satisfactorily replace both the present alpha "poppies" and the present G-M instrument used for beta-gamma surveys. The sensitivities available with the new instrument are better than for the two instruments it replaces. It will also easily detect $C^{14}$ betas.

Development work continued on a portable battery-operated dose-rate integrator for field usage. The device will indicate the total dose received by an individual if the dose rate is known.

Work continues concerning a scintillation system to be used for accurately counting neutron-activated foils. Also continued were investigations concerning different types and assemblies of radioisotope detectors.

Investigations and experimental work continue on a low-level, low-energy autocorrelation system. To be used with such isotopes as $Fe^{55}$ and $Pu^{239}$ both of which emit low-energy gammas. The eventual application of this low-level discriminator and autocorrelation system will be concerned with the digital-type radioisotope analyzer.

A complete final fish scanning system was proposed for the Aquatic Biology Operation. After completing successful tests of an experimental mockup system last month, the final model was designed and presented. If approved for fabrication, the fish scanning system will enable the operator to count the fish for radioisotope content (both magnitude and energy) while keeping the fish alive. The particular isotopes of interest include $Cs^{137}$, $Ru^{103}$, $Ru^{106}$, $Zn^{65}$, $Pu^{239}$, and $Sr^{90}$.

The final model medium-level airborne particulate $Pu^{239}$ counting system was completed and has been tested. This instrument, utilizing a 3.0 CFM airflow rate, can be set to alarm on a 60 MPC level of airborne $Pu^{239}$ in 20 minutes, and at this setting, will not false alarm on Radon-Thoron buildup background.

Extensive advice was given to the Field Development Operation of HLO concerning a type of film densitometer for dose measurements of badge films. The proposed system uses a phototube and thin NaI crystal as a detector and a large 30 $\mu$c $Pu^{239}$ source covered to permit exit of the X-rays only. The film is placed between the source and detector and the attenuation can thereby be measured.

Evaluation tests and reports were completed on sixteen gamma pocket dose alarms, on several alkaline-type portable instrument batteries, on a commercial 0-200 mr pocket dosimeter and charger, on the portable transistorized gamma-energy analyzer, and on a commercial hearing aid-type headphone.

Statistical studies and procedures were devised and tested on several of our developed alpha and alpha-beta-gamma scintillation fixed-filter counters. The information determined enable the field to better obtain accurate fixed-filter counting data.

Some evaluation work was completed concerning light output availability from various scintillators used in the scintillation CP's.

Evaluation work was partly completed concerning the use of G-M tubes as relay alarm activators for remote-area monitoring systems.

The experimental transistorized scintillation slow and fast neutron meter was recalibrated and sent to the field for usage.

## WASHINGTON DESIGNATED PROGRAM

The mass spectrometer being built for this program had its permanent magnet energized this month. The vacuum system is being installed.

## CUSTOMER WORK

### Analog Computing

A series of computer runs were completed which allowed evaluation of a pressurizer tank in the primary loop of an NPR. While the problem was solved in general terms, the effects of using this method to control coolant pressure variations with load were evident. It is anticipated that this problem will be studied in detail at a later date.

The major portion of the Slug Heat Transfer problem has been completed. Results of those portions of the problem requiring long solution times were found to be unsatisfactory due to accumulated machine errors. An attempt will be made to program these long-time solutions into the Digital Differential Analyzer.

The Digital Differential Analyzer is being returned to the vendor for repair. During the period of repair the vendor has agreed to lend Hanford another unit.

Additional computer equipment is being fabricated to allow the solution of the Two Group Multi-Region Flux problem on the analog computer.

It is anticipated that this problem will be set up and preliminary runs completed in September.

Weather Forecasting and Meteorology Service

| Type of Forecast | Number Made | % Reliability |
|---|---|---|
| 8-Hour Production | 93 | 87.6 |
| 24-Hour General | 62 | 86.7 |
| Special | 133 | 90.2 |

Despite a month-end cool wave, the temperature average of 79.4 was a new record high for August. Previously the highest August average was 77.5 recorded in each of three years: 1915, 1923, and 1945. Normal for the month is 74.1.

August closed out the hottest summer season in 47 years of record. The average for June, July, and August this year was 78.2, as compared to a previous high of 76.4 during the summer of 1922 and a normal of 73.3.

Instrumentation

Fabrication continues on a dual-unit alpha air monitor of the scintillation type for use at Purex. The circuit employed in the instrument gives a differential indication for better sensitivity.

The large 5" x 5" crystal detector and phototube instrument for the Regional Monitoring Operation is being tested. The instrument, which employs all transitorized circuitry, is to be used for on-plant and offsite routine sensitive monitoring from the air, on the river, and on land.

Fabrication was partly completed on an alpha AC-operated transistorized scintillation monitoring instrument for use at 234-5. This instrument will replace the older insensitive alpha "Cart Poppies" now in use. The new instrument will be one-fourth as large and cost one-half as much as the "Cart Poppy."

A simulator for statistical studies was completely designed. The simulator will permit statistical studies of fuel element canning and testing procedures in an electrical analog device to simulate actual operation.

Four independent and two dependent variables were incorporated into the instrument. The instrument is for the Operations Research and Synthesis Operation.

Optical

A new borescope camera was 90% completed for use by the Irradiation Testing Operation at 100-K. This camera will photograph process tubes in a reactor. A polaroid camera back is incorporated, thereby permitting immediate picture printing and study.

Routine Optical Shop work included fabrication of nine glass bearings for 200-E, fabrication of a borescope eyepiece, servicing of two underwater viewers at 105-C, fabrication of nine glass bearings for 271-U, assembly of four platinum wire conductivity cells, and modification of a microscope illuminator for Ceramic Fuels Development Operation.

Paul F. Gast

Manager
Physics and Instrument Research
and Development
HANFORD LABORATORIES OPERATION

PF Gast:mcs



[redacted]

VISITS TO HANFORD WORKS

| Name | Dates of Visits | Company or Organization Represented and Address | Reason for Visit | HW Personnel Contacted | Access to Restricted Data | Areas and Buildings Visited |
|---|---|---|---|---|---|---|
| A. Cohen | 7/31 | Army Signal Corp Labs. Ft. Monmouth, N. J. | Discuss unclassified instruments. | WG Spear<br>LV Zuerner | No | 700: 703 |
| L. H. LaFaver | 8/11 | U. S. Forest Service Albuquerque, N. Mex. | Discuss radiography of wood. | IT Myers<br>RB Socky | No | 300: 328<br>329<br>3745-A |
| J. Hassenpflug | 8/11 | Boeing Aircraft Co. Seattle, Wash. | Discuss ionization chambers. | HV Larson<br>WC Roesch<br>RA Harvey | No | 300: 329<br>3745, 3745A, 3745B |
| R. M. Baltzo | 8/14-15 | Univ. of Washington Seattle, Wash. | Calibrate ion chambers. | HV Larson<br>WC Roesch<br>DC Fleckenstein | No | 300: 329<br>3745, 3745A, 3745B, 3702 |
| George Rogosa | 8/13-14 | Div. of Research USAEC, Washington, DC | Discuss neutron cross section program. | BR Leonard | Yes | 300: 303, 305-B, 326<br>100: 105-KE<br>105-DR |
| Robert Schuman | 8/18 | Phillips Petroleum Idaho Falls, Idaho | Discuss cross section measuring techniques. | BR Leonard<br>EJ Seppi | Yes | 300: 326<br>100: 105-KE<br>105-DR |
| R. G. Herb | 8/22 | Dept. of Physics Univ. of Wisconsin Madison, Wis. | Public relations relative to recruiting. | JE Faulkner | No | 300: 326 |

VISITS TO OTHER INSTALLATIONS

| Name | Dates of Visits | Company Visited and Address | Reason for Visit | Personnel Contacted | Access to Restricted Data |
|---|---|---|---|---|---|
| G. E. Driver | 8/5 | General Electric Syracuse, N. Y. | Discuss instrumentation. | G. Kirkpatrick<br>N. Cochran | No |

VISITS TO OTHER INSTALLATIONS

| Name | Dates of Visits | Company Visited and Address | Reason for Visits | Personnel Contacted | Access to Restricted Data |
|---|---|---|---|---|---|
| G. E. Driver | 8/6-7 | General Electric GEL Schenectady, N. Y. | Discuss instrumentation. | J. Hanna<br>W. K. Waldron<br>W. W. Shultz | No |
| | 8/8 | General Electric KAPL Schenectady, N. Y. | " " | L.J. Cherubin | No |
| G. R. Hilst | 8/14-15 | Univ. of Washington Seattle, Wash. | Recruiting. | P. E. Church | No |
| R. A. Harvey | 8/19-22 | WESCON Los Angeles, Calif. | Attend conference. | -- | No |
| | 8/27 | USNRDL Hunter's Point San Francisco, Calif. | Discuss instrumentation. | H.A. Zagorites | Yes |
| P. F. Gast<br>D. S. Selengut | 8/20 | Vallecitos Atomic Lab. Pleasanton, Calif. | Discuss Dresden Reactor problems. | W.J. Ozeroff | No |
| | 8/21-22 | Atomic Power Equipment Dept., G. E. San Jose, Calif. | " " " | W. J. Weil | No |
| J. E. Faulkner | 8/26-28 | American Physical Soc. Vancouver, B. C. | Recruiting at APS meeting. | -- | No |
| W. J. Friesen<br>J. T. Russell<br>B. R. Leonard<br>R. C. Lloyd<br>D. E. Wood | 8/26-28 | American Physical Soc. Vancouver, B. C. | Attend APS meeting. | -- | No |

Chemical Research and Development

ORGANIZATION AND PERSONNEL

J. L. Carroll, Chemist I, and R. K. Henrich, Technical Graduate, summer employees, terminated.

H. T. Hahn, Senior Scientist L, terminated to accept employment elsewhere.

W. W. Marshall, Chemist I-H, terminated to accept employment elsewhere.

V. L. Hammond, Engineer II-L, transferred in from Employee Relations and assigned to Chemical Development Operation.

E. W. Neuvar, Chemist I, terminated to return to school.

L. F. Lust, Chemist II, transferred to Chemical Processing Department.

RESEARCH AND DEVELOPMENT

FISSIONABLE MATERIALS - 2000 PROGRAM

IRRADIATION PROCESSES

Automatic Analyzing Monitor

The instrument was placed in service after being taken out of service for several weeks. Selection of three gamma channels through relay switching to individual base line potentiometers and a common-use pulse height analyzer proved more effective and gave greater stability than the use of three separate single channel analyzers. Long term reliability of commercial components continues to be a limiting factor in sustained operation of the monitor. Some occasional mal-functions are attributable to sample cup imperfections.

Reactor Decontamination

The Irradiation Processing Department plans to decontaminate the B reactor with Turco 4306-B solution. Direct river disposal of the spent cleaner may not be advisable since analyses of effluent from individual tubes cleaned in this manner indicate that a large quantity of radioactive material will be removed. Laboratory experiments were conducted to determine if trench disposal is feasible under the assumption that the trench's main function would be to filter particulate contamination. Ten to fifty percent precipitation of the five isotopes checked were noted when one part spent cleaner was diluted in a thousand parts of river water. Neutralizing the spent cleaning solution with NaOH caused nearly all (85 to 99%) of each of the five isotopes to precipitate. It appears that neutralizing the cleaning solution will permit filtration of most of the radioactive material when the solution is disposed to a trench.

[redacted]

Uranium Oxidation Experiments

Experiments on oxidation of uranium in air were continued with emphasis on the thermal cycling phenomenon. Thermal cycling was not observed at furnace temperatures below 400 C or above 620 C. Within this range, the cyclic behavior of the uranium temperature was proceeded by a period during which the specimen temperature slowly increased above the furnace temperature (termed the "induction period"). At the end of the induction period, a rapid temperature increase of 100-500 C magnitude marked the beginning of the cyclic portion of the oxidation reaction. After 2-3 minutes, the temperature fell rapidly to its previous level, then repeated the temperature peaks at irregular intervals of 10-30 minutes until the specimen was entirely oxidized. The length of the induction period was found to be a function of furnace temperature.

Analytical Service

To assist corrosion studies, an emission spectrographic method is being adapted for aqueous aluminum at the 0.1 ppm level. A precision of ±4.25 percent is indicated.

La-140, Ce-143, Eu-152, Sm-153 measurements can now be made regularly on Columbia River water. Additional 256 - channel energy analyzer calibrations make the measurements possible. Data will assist Radiation Protection programs.

SEPARATIONS PROCESSES

Feed Preparation

Dissolution of Dingot Metal. Alloys of uranium and silicon containing from 10 to 10,000 ppm silicon have been prepared, alpha rolled, and beta heat treated. Instantaneous dissolution rates for samples of these alloys in solutions simulating various stages in a dissolver cut were determined. Rates obtained indicate that Dingot uranium containing less than 1000 ppm silicon (perhaps as little as 300 ppm silicon) will dissolve as rapidly as Ingot uranium. Integral dissolution rates will be obtained to obtain a more reliable comparison.

Redox Solvent Studies

The decontamination performance of a cyclic ketone, 2-methylcyclohexanone, was compared with previously tested solvents. Compared to hexone about ten percent less aluminum nitrate is required to give the same feed point uranium distribution coefficient. The feed point decontamination factor for ruthenium was twice that found with hexone but the cumulative decontamination factor after three scrubs was only two-thirds that with hexone.

The first compounds of a series of diethers being synthesized to develop the "optimum" Redox-type solvent(1) have been tested. Dimethoxy butane was found to be an excellent solvent but is too soluble in water, approximately 17 percent. Methoxy butoxy butane has a very low solubility but is slightly inferior to hexone for uranium extraction. Further structure modifications are being made.

(1) HW-56491, pp 5-6.

Anion Exchange Processes

Higgins Ion-Exchange Contactor. The effects of the resin push pressure on the resin and slip water flow rates were studied under conditions of 0.0 and 2.3 liters per minute combined feed and scrub flow. All streams were off during the resin movement. The resin flow rate vs. push pressure relationship was found to have three distinct characteristics: (1) a "free flow" region, up to a pressure of 23 psig, in which the resin flow rate is linear with push pressure; (2) a "transition" region from 22 to 25 psig where increasing push pressure provides only slight increases in resin flow rate; and (3) a "jamming" region above 25 psig in which an increase in push pressure produces essentially no additional resin flow. It is hypothesized that at higher push pressures (above 40 psig) the resin flow rate will decrease due to jamming.

The optimum push pressure for the system studied (Permutit SK, 20 to 50 mesh anion exchange resin in two molar nitric acid) appeared to be 20 to 23 psig. At this pressure the resin flow rate is near the maximum, with a slip-water-to-resin flow ratio of approximately 40 percent. While the exact pressures will vary with the system and total length of resin bed, it is felt that the general relationships will remain valid.

The effect of instantaneous vs. gradual application of the push pressure on the resin and slip water vs. pressure relationship was also studied. While both the minimum pressure required to push the resin and the slip-water-to-resin flow ratio were increased by a gradual push, a much smoother resin movement was secured with the gradual-opening motorized ball valve.

Flurex Development

Radiation Stability of Ion Exchange Membranes. Commercially available ion exchange membranes (Permutit, Nalfilm, and Nepton) showed a slight decrease in membrane potential after irradiation to $3.5 \times 10^8$ R (254 hours at $1.4 \times 10^6$ R/hr) in a Co-60 gamma field. Electrical resistance and physical appearance of the membranes remained unchanged except for a brown discoloration of the Permutit and Nalfilm membranes. Determination of transference numbers by the direct transference method will be done to assay the effect of the irradiation on the permselectivity of the membranes.

Life Testing of Ion Exchange Membranes. Long term runs to determine the useful life of ion exchange membranes under proposed Flurex operating conditions are being continued. Permutit 3142 cation membrane appears to have a useful life of at least 1000 hours at one amp/in.$^2$ and 60 C. A slight loss in permselectivity was observed during this exposure. At anticipated current densities (ca. one amp/in$^2$), temperature appears to be the most important factor influencing membrane life. Current runs are at 30 C.

Evaluation of New Permutit Cation Membranes. Two new Permutit Co. cation membranes, Permutit 3143 and 3155, are being evaluated for possible use in the Flurex cell. The hydraulic permeability of these membranes is much less than that of Permutit 3142; electrical resistance is greater. As with Permutit 3142, the resistance of these membranes is markedly reduced by exposure to distilled water at 90 C. After one hour of this treatment hydraulic permeability and electrical resistance of these membranes are about 1/200 and four times, respectively, that of Permutit 3142. The limiting current density is about 2.3 amps/$in^2$ for both new membranes and about 3.2 amps/$in^2$ for Permutit 3142. It is independent of feed compartment UNH concentrations in the range 0.5 to 1.5 M.

## Pyrochemical Processing

Reduction of Plutonium with Magnesium. Because of the surprisingly high plutonium reduction yields obtained by the addition of magnesium to the KCl-$AlCl_3$-$PuCl_3$ system, an experiment was performed to study the reduction of plutonium trichloride in the absence of aluminum. When 0.0022-mole of plutonium trichloride in a large excess of NaCl-KCl eutectic was heated for ten minutes at 800 C with a three-fold excess of magnesium (as a zinc-9 w/o magnesium alloy), over 95 percent of the plutonium was reduced to metal. The resulting zinc button was heated to 600 C for 200 hours under a vacuum of 1 x $10^{-6}$ mm Hg to remove zinc and magnesium but the results of this step are unknown.

The function of the zinc is two-fold: (1) it modifies the density of the magnesium so that it does not float (possibly permitting an air atmosphere); and (2) it serves as an inert diluent for the plutonium (possibly alleviating container problems). The zinc also serves to reduce the activity of the plutonium, thus tending to drive the reaction in the direction of reduction.

This finding is of significance since it could possibly lead to an open pot process for plutonium. Further experimentation will seek an optimization of parameters with emphasis on reduction of the inert components of the system.

Thermodynamics of Double Salts and Alloys. Attempts to correlate the calculated free energy changes of the reduction of uranium, plutonium and cerium chlorides by aluminum or magnesium in the presence of potassium chloride with those determined from equilibrium data (assuming unit activity coefficients) have resulted in discrepancies ranging from 10 to 40 kilocalories. It is therefore evident that activity coefficients in the potassium chloride melts are drastically altered.

In order to understand the role of the solvent (in this case potassium chloride), the system was analyzed on the basis of the charge density approach of Komarek and Herasymenko (J. Electrochem Soc. 105, 216 (1958)) and the following conclusions were drawn.

1. Of the ions considered (alkali, alkali earth and aluminum) aluminum should have the greatest tendency to complex.

2. Greater complexing of aluminum chloride with chloride ion will occur if the solvent is cesium chloride or rubidium chloride than with potassium chloride. Complexing will be weaker in sodium chloride, lithium chlorides or any of the alkaline earth chlorides.

3. Plutonium, uranium and cerium chlorides have about the same complexing tendencies as calcium chloride but less than magnesium chloride and much less than aluminum chloride.

Reference to the above conclusions has enabled an analysis of the experimental data so far obtained which shows that the discrepancies in "measured" and calculated free energies of reaction are not unreasonable. It also points out the possibility of "shaping" the characteristics of the system by modifying the salt phase.

Separation of Uranium and Thorium in the $KAlCl_4$ System. When an aluminum-9.5 w/o thorium - 8 w/o uranium alloy was contacted with an approximately equal weight of potassium aluminum chloride at 700 C, less than five percent of the thorium was retained in the metal phase, while the bulk of the uranium remained. Apparently less than four minutes were required for the system to equilibrate, as metal samples withdrawn at five minute intervals thereafter showed no change in composition over a 30 minute period.

Similar separations of thorium and uranium were also observed when natural uranium-aluminum alloys were equilibrated with potassium aluminum chloride. After equilibration the normal beta-gamma activity of the alloy was not detectable with the laboratory survey instrument (VGM).

This technique may be useful for separating the highly radioactive thorium-228 contaminant from uranium-233-aluminum alloys in the production of MTR type or other fuel elements. It may also have application to the separation of uranium-233 from thorium-232 blanket material.

Analytical Service

Nitrate is being measured in Darex solutions that contain significant chloride concentration. The method is based upon phenyldisulphonic acid complexing. Error is less than 10 percent. Silver (as sulfate) removes chloride interference prior to color measurement at 405 mu.

The colormetric thoron method was used to measure 0.3 to 9 percent thorium in Al-U-Th alloy. Error is 10 percent. Aluminum did not interfere. Uranium corrections were applied.

The Karl Fisher method was used to measure the water picked up by originally dry plutonium chloride stored up to 20 days over sulfuric acid (1.60 sp.gr.). The chloride was placed in flat-sided vials for drying at 500 C in argon,

Weight percent Pu-239 in Np-237 product is being determined directly with a 256 - channel energy analyzer. The method works well as long as visible solids are absent from sample plates. Error is 50 percent at 0.003 w/o Pu-239, 10 percent at 0.01 w/o Pu-239, and about 2 percent at higher plutonium impurities.

Np-237 is being separated from highly active plant waste by means of a lanthanum fluoride strike, dissolution in aluminum chloride solution, and TTA extraction of quadrivalent neptunium. The method gives excellent Zr-95 - Nb-95 decontamination. Both Np-237 yield and purity are well above 95 percent.

## WASTE TREATMENT

### Calcination of Purex Waste

The effect of calcination time on the volatilization and leaching of fission products from Purex 1WW was studied at 400 and 800 C. The fraction volatilized did not change markedly for heating times ranging from 5 minutes to 24 hours. For 400 C calcination, the leachability of the residue was also not affected, but at 800 C the leachability decreased greatly - from 73 percent leached after five minutes heating to only three percent after 24 hours. Other experiments showed that higher temperatures, 1000 C and 1400 C, resulted in low fission product leachability independent of the initial composition of the waste. However, volatilization of sodium salts and cesium was evident at the higher temperature. A summary progress report is being issued on the volatilization and leaching studies to date.

### Calciner Development

Design of the eight-inch demonstration spray calciner was completed and turned over to the technical shops for construction.

Several runs were made in the 222-S agitated trough calciner. Feeds included (1) an acid killed (formaldehyde treated) 1WW, (2) a similar feed with phosphate and borate addition, and (3) a simulated ICPP aluminum nitrate waste. Scale build up and excessive fines production were observed with the first feed, about one-half of the solids being carried out with the off-gases. The solution containing phosphate and borate calcined without difficulty with little indication of scale formation and negligible carryover of fines. The product had a satisfactory density of 1.24 gms/cc. The run with acidified aluminum nitrate was made to compare paddle trough calciner and fluidized bed operation (extensive fluidized bed studies have been made with this feed at Idaho Falls). The resulting product was very similar in appearance to that obtained in the fluidized bed; however, dusting appears to be more of a problem in the paddle trough calciner (20 percent carryover). In other experiments, it was not possible to operate the paddle trough calciner with neutralized 1WW, even when the temperature was kept below the melting point of the bulk component, sodium nitrate. It may, however, be feasible to calcine neutralized waste in a fluidized bed reactor operating well above the decomposition temperature of sodium nitrate. This may require heating by direct combustion within the fluidized bed to temperatures of the order of 800 C.

Nitrate Destruction

Construction and installation of pilot plant equipment for the destruction of nitric acid with formaldehyde are 90 percent completed.

Laboratory experiments on the electrolytic destruction of nitric acid (to NO and $NO_2$) were continued. In a two-compartment cell using a Permutit 3142 cation membrane, a stainless steel cathode and a Duriron anode, current efficiencies ranged from 90 percent (2.1 g $HNO_3$/amp-hr) with 8 M $HNO_3$ to 50 percent (1.2 g $HNO_3$/amp-hr) with 4 M $HNO_3$. One experiment with 2.6 $HNO_3$ gave no reduction.

In a batch electrolysis of synthetic Purex 1WW, 88 percent of the free nitric acid was destroyed at an over-all current efficiency of 57 percent with a stainless steel cathode, no diaphragm, and a Duriron anode. The cell voltage was 5.0 volts at a current density of 1.5 amp/$in.^2$ During the course of the electrolysis, the solution volume decreased by a factor of three. Although electrode corrosion rates were not measured, other tests with nitric acid as electrolyte have given corrosion rates of about 25 and 4 mg/amp-hr for the anode and cathode, respectively.

The cell reaction appears to be altered by the presence of a diaphragm or membrane. With a cation membrane separating the anode from the cathode, nitrogen oxides are evolved at the cathode. With no diaphragm, only minor amounts of gas are evolved at the cathode.

Observation Wells

Few significant changes in contamination level were found in monitoring samples from ground water wells. The concentration of beta-emitting contamination in the ground water beneath the abandoned 216-A-8 crib decreased by about 90 percent (to about $10^{-4}$ $\mu$c/cc). The ground water beneath the 216-A-24 crib, which now receives Purex boiling tank condensate, has a gross concentration of radioactive contamination of about $10^{-5}$ $\mu$c/cc.

Discussions with rotary drilling contractors and drillers about use of rotary drilling techniques at Hanford reiterated the belief that speed and cost favor rotary methods over cable-tool (churn) drilling. A new type of core sampler for unconsolidated materials was studied. The sampler reputedly takes continuous core at rates in excess of 40 feet per day in Hanford-type materials. Present drilling rates with cable tool equipment average 15 to 20 feet per day, and provide broken, disturbed samples. Use of rotary drills and core samples may procure data faster and cheaper than by standard cable tool methods.

High Level Wastes

Preparations have been made for conducting a third field-scale test simulating loss of Redox high-level waste from a leaking tank. This test, planned to be conducted on August 27, 1958, will be a duplication of the second test but with the equipment modified to eliminate plugging of the orifice by sludge.

A sparge line has been installed immediately above the orifice so that the sludge can be maintained in suspension during the test. Sparge air will be supplied by a portable, gasoline-driven compressor.

Laboratory apparatus for permeability measurements of simulated thermally hot high-level wastes was further tested and improved. An incremental volume meter was devised and tested which permits a record of throughput rates during the course of the experiment. Better pot heater control was provided. A smaller column for use with the apparatus was designed and ordered fabricated.

The permeability of a soil column for synthetic high level waste solutions was determined at different column temperatures and for two waste concentrations. Through a column of sea sand, unconcentrated waste had a permeability about 0.4 of that of water. A waste solution concentrated 1-1/2 times had a permeability about 0.3 of that of water through a similar column. The permeability of both water and the waste solutions through the sand columns increased with increasing temperature.

Further refinements in experimental technique were incorporated in centrifuge tests of specific retention of synthetic high level wastes in soils. It was found that greater reproducibility of results was obtained when samples were subjected to a 12-hour "humidifying" period prior to centrifuging, thus insuring proper moisture distribution and complete saturation of the sample. Filtered, synthetic Redox waste appears to drain from soils about 60 percent as readily as pure water.

Disposal to the Ground

Equilibrium distribution tests were performed to demonstrate the influence of calcium in the soil on the retention of strontium from wastes. Specifically the data were obtained to resolve some anomalous results from recent soil column and equilibrium tests with unneutralized process condensate wastes from Purex. Soils were used in these tests that were previously leached with aliquots of 0.1 N nitric acid to remove calcium. The equilibrium distribution coefficient for unneutralized process condensate waste with acid leached soil was found to be more than twice that measured for the same waste and unleached soil.

Analytical Service

Crops, such as strawberries, potatoes, apricots, and carrots, are being regularly analyzed for 11 elements as radioisotopes. The current Sr-89 and Sr-90 methods are insufficiently sensitive. Sensitivity must be refined from $7 \times 10^{-8}$ $\mu$c/cc to $2 \times 10^{-8}$ $\mu$c/cc. Based upon Chemical Research experience, special laboratory facilities will be isolated and modified to help meet that goal. The 256 - channel energy analyzer permits saving one hour per Sb-125 analysis in soil.

FISSION PRODUCT AND TRANSURANIUM ELEMENT AND RECOVERY

Neptunium Recovery

Laboratory Studies. Several miniature mixer-settler experiments were carried out to test 3WB "reduced" flowsheet processing (ferrous sulfamate used to hold neptunium in the IV state). With a two molar nitric acid, 0.05 molar ferrous sulfamate scrub, satisfactory runs were made with both four and eight molar nitric acid feed. The high acid experiment using a Purex 3WB sample taken in May resulted in a high neptunium reflux in the HA system. One percent of the product appeared in the HAP and HAW streams after six hours of operation. Although not yet explained, this points to the need for more information on the kinetics of valence changes of neptunium in nitric acid systems.

The total reflux 2A-2B flowsheet was also tested with the Mini. Concentrated nitric acid was mixed with the 2BP stream and fed back to the 2AF as four molar nitric acid. The original feed contained four molar nitric acid and 0.05 molar ferrous sulfamate. Although the ultimate purpose of this flowsheet is to improve fission product decontamination factor and to increase the neptunium concentration, the Mini run was carried out to investigate its operation from a waste loss standpoint. The waste loss was 0.7 percent of the neptunium at the feed point, using ten Mini stages in the extraction section.

The final experiment tested the "oxidized" flowsheet. The feed was 4.75 molar nitric acid, 0.05 molar dichromate and the scrub, 0.5 molar nitric acid. The system behaved very well using plant solvent, and no neptunium was detected in the waste. The oxidized flowsheet has some advantages with respect to higher neptunium concentration and possibly better decontamination factor due to the lower acidity.

The recovery of neptunium from Purex 1WW was demonstrated by measuring distribution coefficients into 30 percent TBP under various conditions of complexing and salting. The addition of 0.4 molar aluminum nitrate improved the neptunium distribution coefficient by a factor of 1.8, probably as a result of both sulfate complexing and salting.

Two solvent extraction methods were demonstrated for removal of final traces of plutonium from neptunium: 30 percent TBP using ferrous sulfamate reductant, and TTA in benzene.

Anion exchange was selected as the method for neptunium recovery from the Purex concentrate. Several laboratory experiments were carried out to show that neptunium could be efficiently loaded from a ferrous sulfamate-nitric acid system and separated from plutonium. In addition, the use of cation exchange to remove plutonium(IV) from neptunium(V), as a final clean-up, was tested and found to give excellent plutonium decontamination factors.

Neptunium Processing. A four-inch diameter column filled with six liters of Dowex 1, X-4 (50 - 100 mesh) was installed in the 222-S Building IF cubicle. The existing equipment in the cell, tanks, pumps, lines, etc., was adapted to the ion exchange unit. After a shakedown run with ferrous sulfamate-semicarbazide-nitric acid, two lots of Purex concentrate were successfully processed.

The operation was quite successful. Gas formation in the resin bed was not severe and was minimized by operation under slight pressure with occasional degassing. The plutonium decontamination factor in the first run was not good probably as a result of incomplete reduction. The feed for this run contained greater than 0.1 molar ferric iron which, together with the high neptunium concentration, gave unfavorable equilibrium conditions for plutonium reduction. In both runs further washing and/or separation of the initial elution fractions would have greatly increased the plutonium decontamination factor.

A very high beta reading was obtained from the first elution samples. This was apparently from $UX_1$, which was rather efficiently concentrated in the Purex plant. There is some evidence that an appreciable concentration of long-lived thorium is also present. Final purification from $UX_1$ and from plutonium was made by cation exchange using Dowex 50. The neptunium oxidized to the V state with $NO_2$ gas passed through the resin, while plutonium(IV) and thorium remained. The product delivered to 234-5 contained 0.05 percent plutonium based on the neptunium content.

Neptunium Oxide Preparation

The precipitation of a one gram quantity of neptunium(IV) oxalate and subsequent calcination to the oxide was demonstrated in support of the neptunium recovery program.

Cesium Recovery

Reasonably complete analytical results have now been obtained on the solid material found in Purex plant 1WW. These show the solid to be primarily silicic acid with lesser amounts of zirconium, chromium, iron, and copper. The zirconium is undoubtedly fission product zirconium, and a reported trace of palladium is also probably of fission origin. From 50 to 90 percent of the zirconium and from 90 to 99 percent of the niobium present in Purex feed is found in the precipitate. Analyses for plutonium were highly variable, both between samples and between laboratories, but indicated that most of the plutonium was in the supernate.

Another liter of 1WW has been loaded into the cell for an "acid side" (zinc ferricyanide) run. It will also be used, prior to cesium recovery, to test the recovery of plutonium and neptunium from 1WW by anion exchange as well as to test flowsheets for cerium and strontium recovery.

A paper (HW-57280) was issued summarizing the analytical results which have been accumulated on the composition of Purex 1WW.

Strontium Recovery

Laboratory work on the use of fuming nitric acid precipitation as a primary process for the recovery of radio-strontium from Purex 1WW has been concluded and a report is being prepared. Briefly, the process consists of bubbling nitrogen dioxide and oxygen into 1WW to increase the nitric acid concentration and precipitate strontium nitrate. Formaldehyde treatment of the waste can then be used to re-generate the nitrogen dioxide. Using synthetic solutions and simulating the various steps of the proposed flowsheet, strontium yields of up to 80 percent were achieved. Attempts at integrated testing were disappointing, however, due to difficulty in generating fuming nitric acid on a small scale. It is thought that these difficulties are due to the scale of operation and would not obtain on a plant scale. Engineering development work is considered warranted.

Other strontium recovery work has been aimed at firming up a "basic side" carrier precipitation process for full level testing in the 222-S Multicurie cell.

Cesium Packaging Prototype Facility

Detailed construction drawings for the Cesium Isolation and Packaging Facility are approximately 90 percent complete.

Development work included the fabrication of four test vessels to determine the effectiveness of the metal "O"-ring seal designed for the proposed product containers. These seals are to be subjected to a series of tests which include various combinations of elevated pressures and temperatures. Also a work coil and the essential elements of the inductively heated ball mill were fabricated to determine the performance characteristics of the basic design of the hydrolyzer.

ANALYTICAL AND INSTRUMENTAL CHEMISTRY

Neptunium Titrations

A preliminary investigation of the analysis of neptunium by controlled potential coulometry has shown favorable results from microgram to milligram quantities of the neptunium. Microgram quantities of neptunium have been titrated in the presence of a hundred-fold excess of plutonium and a thousand-fold excess of iron without apparent interference. Titrations of two process samples of neptunium were performed using the (NpV/VI) couple and a platinum cathode. The results were within three percent of X-ray absorptiometer and alpha count values, but the values based upon alpha counting tended to be consistently lower.

Coulometric Titration of Plutonium in Dissolver Solutions

A controlled potential coulometric titration procedure for the direct determination of plutonium in HAPO dissolver solutions has been developed. Comparisons of titration and alpha counting results on several representative dissolver solutions are being made and the preliminary data indicate that the method is accurate. The precision of the method is ±1.0 percent at the 95 percent confidence level for a single determination. The method is much more rapid than the alpha

and isotopic analysis procedure now used for samples of indefinite irradiation history. The procedure is briefly as follows: a sample containing from 100 to 200 micrograms of plutonium is added to five milliliters of 1 N HCl containing sulfamic acid. The plutonium is first adjusted to plutonium(III) coulometrically and then titrated twice, first to plutonium(IV) and then back to plutonium(III). The formal reduction potential of the plutonium III/IV couple in the system is measured during each titration. The iron in the sample is then titrated and its electrode potential also measured. The calculations include a small iron correction using the measured EMF formal values in the Nernst equation.

New Counting Methods

Liquid scintillation counting was found suitable for direct counting of Zr-95 and Nb-95 in mixtures without prior separation from each other. This beta counting technique supplements gamma scintillation counting which is only capable of determining Zr-95 and Nb-95 together because of the nearly equal energies of their gamma rays.

EQUIPMENT AND MATERIALS

Nonmetallic Materials Testing

Five different polyurethane rubbers (Adiprene B-1, Adiprene B-2, Adiprene C, Disogrin DSA 6865, and Genthane S)(1) were tested by static immersion at room temperature in a number of typical separations plant solutions. All samples were decomposed by 60 percent nitric acid within one hour. None of the samples were damaged by 10 percent nitric acid during the first 24 hours; however, failure did occur in less than one week. Twenty-four hours immersion in Recuplex CAX caused approximately 40 percent swelling. All of the samples will withstand one hour submersion in Recuplex CAX, Purex HAX, carbon tetrachloride, and hexone with no damage, but longer exposure to any of these solutions will cause serious degradation. Good quality gloves can be made of polyurethane rubber.

After 40 days room temperature submersion in lard oil, no changes can be detected in either regular Plexiglas(2) or Plexiglas 5009.(2)

Samples (0.032 inch thick) of cementable Rulon(3) were cemented with a one inch lap with Eastman 910 adhesive and tested by static immersion at room temperature in several solutions. It was not possible to separate the samples which were immersed for 28 days in 50 percent caustic soda or in distilled water. The cemented joints could be peeled apart only with difficulty after 28 days in 10 percent nitric acid, carbon tetrachloride, Recuplex CAX, Purex HAX and hexone. The sample which was tested in 60 percent nitric acid could be peeled apart with relative ease but in direct shear the Rulon broke before the joint yielded.

(1) Trademarks of du Pont - Adiprene; Greer Industries - Disogrin; General Tire and Rubber Company - Genthane.
(2) Trademark of the Rohm and Haas Company transparent plastic.
(3) Trademark of the Dixon Corporation filled polytetrafluoroethylene.

SECRET

Redox Silver Reactor

Studies are in progress to determine cause for failure of the saddle support screen in a Redox plant silver reactor during cleaning with hot water and 2 M sodium thiosulfate solution. The one-quarter inch mesh stainless steel screen is supported on a grid of one-eighth by one inch stainless steel bars. Visual examination showed negligible corrosion of the reactor shell, very slight attack of the support bars, and severe pitting attack over the entire screen. Laboratory studies indicate the attack was not due to the cleaning solutions used. A study of possible attack by silver salts (which accumulate on the screen) in the presence of water vapor at high temperature is underway.

PROCESS CONTROL DEVELOPMENT

Electrodeless Conductivity Measurements

The range of the conductivity monitor has been extended up to 4.5 M nitric acid. A 26 m.v. change in output voltage is now realized for a change in concentration of from 0 to 1.4 M, and a 4 m.v. change for a change from 1.4 to 4.5 M nitric acid. It is possible that if the oscillator voltage change is due to a loading phenomena, even higher concentrations of nitric acid may be detectable. However, if the phenomena are strictly due to an electrical conductance change, the maximum in specific conductance that occurs at 4.5 M for nitric acid, will be the limiting factor. The stability of the oscillator was substantially improved by increasing the frequency of operation. The 955 triodes used in the transmission line oscillator show no ill effects after exposure to $10^8$ roentgen gamma radiation.

Purex HA Column Densimeter

A hydrometer type densimeter located immediately above the HA Column feed point was put into service in the Purex Plant on August 21, 1958. The instrument appears to be operating satisfactorily. It is somewhat over sensitive without considerable dampening, but readily responds to density changes. Research and Engineering personnel are currently correlating and evaluating the data furnished by the instrument.

Looped Tube Densimeter

Installation of a thermistor in the strain gage bridge circuit has reduced temperature error to negligible values. Remounting of the strain gage has reduced signal variation due to flow rate changes by a factor of three, with only a slight reduction in total output signal. These charges have allowed the full scale range to be reduced to 0.100 specific gravity units. The device is now being installed for testing on an extraction column line in the cold semiworks.

Calciner Instrumentation

All recording and controlling instruments to be used in the simulation of the calciner feed control loop are being installed in the cold semi-works. The pneumatic unit for operating the four feed control valves during start-up and shutdown was fabricated and adjusted for use. Tests to evaluate overall performance of the simulated system will begin in the near future.

IC Column Instrumentation

The 321 Building, 3-in. glass IC Column has been revised to facilitate its use in obtaining data suitable for the development of a IC Column analogue. To decrease time lag errors, column holdup volumes on either side of the extraction cartridge have been reduced to a minimum and the stream analyzers moved as close to the column as possible. Conductivity-type instruments have been installed in the cartridge and will be evaluated for a flooding detection device.

NON-PRODUCTION FUELS REPROCESSING

Mechanical Processing Prototype

Cell Design. Studies were continued for the design of a "minimum equipment" mechanical processing cell in which fuel elements can be size-reduced for dissolver feed. In this cell, saws for end-fitting removal are eliminated and the entire chopped fuel element discharges from a shear directly into a dissolver screen bucket. Problems of dust control and pyrophoricity are thus minimized.

Shear Installation. Installation of a 40-ton hydraulic shear in the 321-A Building for the development of fuel element size reduction technology is 60 percent complete. Initial cuts on simulated fuel elements are planned for the first week in September 1958.

Feed Preparation

Darex. Continued operation of the prototype Darex dissolver has confirmed the passivation effects and erratic dissolution rates reported last month.

In one particular run, 4 M HCl - 2 M $HNO_3$ was metered to the dissolver which contained 1/2-inch O.D., 32 mil wall, type 304 stainless steel tubing in 2 M $HNO_3$. The dissolution did not start until the chloride concentration was 0.6 molar. When half of the stainless steel was dissolved, the aqua-regia addition was stopped and the solution was allowed to stand for 20 hours. The solution contained insufficient chloride to complete the dissolution. When the aqua-regia addition was resumed, the remaining stainless steel failed to dissolve immediately. After a period of five hours at boiling, the residual stainless steel started to dissolve rapidly and the reaction was difficult to control. Ninety-one percent of the stainless steel charge dissolved to a terminal concentration of 0.8 molar. Conversely, in a 1 M HCl - 2 M $HNO_3$ solution, 1/2-inch O.D. stainless

steel tubing was 99.7 percent dissolved in five hours and a piece of 3/4-inch 304-L bar stock was 82 percent dissolved. The dissolution proceeded smoothly to a terminal stainless steel concentration of 0.4 molar.

Bench studies have been initiated to find means of activating stainless steel that was passive to boiling dilute aqua regia. Activation was secured by physically contacting the passive material with active stainless steel, carbon steel, copper, aluminum, mercury, or vapors from cold, concentrated aqua regia. The addition of $I_2$, NaOCl, $FeCl_3$, $Ni(NO_3)_2$, $Hg(NO_3)_2$, and $NaNO_2$ were ineffective, as was sparging with air or chlorine. Titanium in boiling dilute aqua regia was observed to evolve some bubbles when placed in contact with aluminum. No bubbles were seen when contact was made with copper, mercury, or active stainless steel.

In other laboratory studies the passivity of stainless steel was studied as a function of varying nitric and hydrochloric acid concentrations. No significant passivation was noted in any case in which the dissolvent contained less than 4 M $HNO_3$ and greater than 1 M HCl. Some steel specimens were passive to dissolvents containing low hydrochloric acid concentrations (1 M or less). These were also passive to nitric acid solutions containing 2 M HCl when the nitric acid was 4 M but not at lower nitric acid concentration. Those specimens active at low hydrochloric acid concentration were also active in 5 M $HNO_3$ - 2 M HCl.

Zirflex. Experimental dissolutions of Zircaloy-2 clad uranium dioxide pellets have continued under preliminary flowsheet conditions (HW-56752) and alternate conditions employing an air sparge in the dissolver in lieu of water boil-off for ammonia purge. Small amounts of oxidized zirconium (5-10 percent of the charge) continue to remain after 11 hours in the dissolver. However, the uranium is apparently essentially completely dissolved by a subsequent nitric acid dissolution step.

A 3-inch diameter glass de-entrainment tower packed with 1-inch stainless steel Raschig rings was installed on the pilot plant unit to scout the behavior of any zirconium entrained in the off-gases. Only traces of zirconium hydroxide were observed in the tower and no localized build-up occurred when the reflux was discharged to the pot above the liquid level. Vapor velocities in the tower were calculated at approximately 4 ft/sec.

## Solvent Extraction

Solution Stability. A large number of solutions simulating Redox IA Column feeds (IAF) which could be prepared from Darex Process dissolver solution (chloride removed) has been prepared and observed for stability with respect to precipitation. In these solutions, uranium to stainless steel ratios from 0.5 to 5, uranium concentrations from 0.5 to 2.0, and free nitric acid concentrations from 1.0 to -0.9 were employed. Many of these solutions are stable. However, all of the stable solutions are at low pH (ca. 0) compared to that of currently used Redox IAF (ca. 1). Other solutions simulating Redox IA Column feed point conditions (IAFS) and waste raffinate (IAW) were prepared

assuming the above IAF compositions and Redox HW No. 4 flowsheet. These also were observed for stability toward precipitation. In addition, several mini mixer-settler runs have been made using some of the above IAF solutions and HW No. 4 conditions to observe stability of the aqueous phase in the IA Column extraction section. No instance of instability in the extraction section not predicted from instability of the IAF or corresponding IAW has been observed.

Similar Redox process solution stability studies are in progress for feeds which can be prepared from nitric-hydrofluoric acid (Niflex) dissolution of stainless steel clad fuels. Preliminary data indicate that stable feeds can be prepared having a pH more nearly that for current Redox IAF than attainable with Darex feeds. This observation is attributed to the complexing of iron and other stainless steel components by fluoride present in these solutions. Precipitation of the hydroxides or hydrated oxides of these metals at higher pH is prevented.

Batch Contact Studies. Batch contact studies were started to determine fission product distribution under Redox IA conditions using simulated Darex IAFS spiked with Purex plant dissolver solution. Acidity, U/stainless steel mole ratio, and total salt strength are the variables under consideration. Complete analytical data are not yet available. Preliminary numbers indicate a decrease in gross gamma $E_a^o$ by a factor of about 100 as the acidity is decreased from +1.0 to -0.3 M. The $E_a^o$ at -0.3 M acid was less than twice that obtained when conditions simulating Redox No. 4 flowsheet were used.

Uranium extraction from simulated Darex-dissolved Redox feeds was also studied in batch contacts. Distribution coefficients obtained were all as high or higher than obtained under Redox No. 4 flowsheet and indicate no difficulty in obtaining adequate uranium recovery.

Packed TBP Solvent Extraction Columns. The relatively low "C" column flooding capacities reported last month were increased by 30 to 70 percent by employing graded and "zebra" packings. For example, the flooding capacity of the column was increased from the 700 gal/hr.ft.$^2$ secured with a uniform 1/2-inch stainless steel raschig ring packing to 1040 gal/hr.ft.$^2$ by removing 3-1/2 feet of packing from the bottom of the column and replacing only the uppermost two feet with one-inch stainless steel raschig rings. Other packing configurations employing alternate bands of fluorothene and stainless steel raschig rings flooded at throughputs from 900 to 1440 gal/hr.ft.$^2$ Efficiency studies employing dilute C Column conditions are underway; however, color line observations and waste loss determination have indicated the efficiencies of the graded and "zebra" packings are comparable with that of uniform packings.

Redox Processing of NPF Feeds. Preliminary arrangements have been made with the Chemical Technology Division, Oak Ridge National Laboratory, to provide semiworks scale demonstration of the basic feasibility of processing NPF fuel feedstock in packed columns under modified Redox conditions. Similar demonstration at HAPO would require large expenditures to provide the necessary explosion proof facilities. It is anticipated that the studies will start in September.

## Criticality Study Materials Preparations

During the unloading of the first set of tanks (containing $UO_3$, polyethylene pellets and trace amounts of water) after testing in the PCTR, minor pressure build-ups were observed in several of the tanks. Revisions are being made to the tanks to provide for pressure relief and sampling prior to future loadings, both to identify the problem and to eliminate any potential hazard.

It is believed that the pressure build-up is not characteristic of the materials employed in the present experiments but rather has not been previously detected because of the containers used in previous experiments. These had much looser seals and would probably remain at atmospheric pressure at all times.

## REACTOR DEVELOPMENT - 4000 PROGRAM

### Non-Rigid Fuel Cores

A summary report entitled, "Bismuth Slurries as Reactor Fuels," HW-57161, has been written.

### Mercury Isotope Separation

Results of the isotope separation experiment reported in HW-56640 C, have been received from Consolidated Electrodynamics. A separation factor for Hg-204 (related to the starting material) of about 1.0035 was obtained, which is about 50 percent of that obtained by Harkins (see HW-54812).

## BIOLOGY AND MEDICINE - 6000 PROGRAM

### Analysis of Reactor Effluent Water

Decay counting techniques were used to measure the individual cerium radioisotopes from two reactor effluent water samples because of the importance of the long-lived Ce-144 - Pr-144 in hazard estimations. The results are tabulated below. The Ce-144 - Pr-144 values are still preliminary and may be changed a few percent by results of continuing decay measurements.

| Isotope | Concentration $\mu c\ ml^{-1} \times 10^6$ Sample 1 | Sample 2 |
|---|---|---|
| $Ce^{141}$ | 0.90 | 0.48 |
| $Ce^{143}$ | 1.8 | 1.2 |
| $Ce^{144}$-$Pr^{144}$ | 0.3 | 0.13 |

Analysis of Radioactivity in Urine

A large sodium iodide scintillation well crystal which can accept a 500 ml sample in its well is under test for application to direct counting of radioisotopes in urine samples. Fifty percent of the gamma rays from Cs-137 are counted in the photopeak with a background counting rate of about 50 cpm. This sensitivity approaches that of chemical isolation and beta counting methods, yet requires no sample preparation. This technique will be tested on other radioisotopes and should prove especially suitable for volatile radioisotopes such as Ru-103 - Ru-106 and I-131 which are lost in usual bioassay sample preparation methods.

Radiation Damage Inhibitors

Studies indicate that salts containing organic anions are good protective agents for inhibiting radiation induced bleaching of aqueous erioglaucine solutions since the negative charge on the anion increases the electron density throughout the molecule. In addition, the anion forming group in the molecule tends to solubilize the compound in water and, thus, increases its utility for protecting aqueous systems.

Geology and Hydrology

A well drilled in the PRTR site for process water was sampled during drilling and during a pump test. Knowledge of the vertical distribution of uranium contamination in the ground water permitted development of aquifers showing only low contamination. The pump test disclosed the presence of $6.6 \times 10^{-8}$ $\mu$c U/cc in the water, about one-fifth that in the nearest shallow well. A few water level measurements made during the pumping test were used to estimate the average permeability of the aquifer beneath the site. The test was performed by a contractor to establish the potential water supply from a well near the PRTR installation. The measurements made indicate an average permeability of about 1600 gal/day/ft$^2$ for this undifferentiated Ringold aquifer.

Laboratory model tests are in progress to collect data to demonstrate the applicability of the recently developed, unsaturated flow formula. The model consists of a thin vertical bed of sand, simulating a vertical slice through a crib. The moisture content of the bed at various points beneath the crib was determined by means of tensiometers installed in the vertical face of the model. Tests thus far completed with the model were designed to evaluate the tensiometers constructed for measuring moisture content in an equilibrium model crib system.

Field Apparatus Development

Additional surveys were made with the vertical field magnetometer to investigate this method of determining basalt features. The surveys located additional basalt ridges of interest and further delineated previously surveyed formations. Effort to establish relations between magnetic intensity and depth to basalt was not successful.

[redacted]

The thermistor ground water velocity meter was tested in a sandbox model well. Flow achievable through the model was too low to properly evaluate the instrument. These tests indicated, however, that actual wells give more stable response with less background than the model well tested.

Ground Waste Investigations

A soil column test utilizing a 12-foot long, 2 cm diameter column was completed as part of the research to evaluate the influence of column dimensions on the breakthrough data. The results of this test are very close to that obtained for a 120 cm column, indicating the minor influence of the length of column used. The slightly more rapid breakthrough observed for columns of less than 120 cm in length is believed to result from differences in the packing of the larger columns. The similarity of the breakthrough curves for different size columns tends to indicate the applicability of short column tests for the evaluation of crib life.

Soil Chemistry and Geochemistry

Research is in progress to find mineral bed reactions for the decontamination of acid waste solutions. Certain wastes, such as the Z-Plant laboratory and process waste, form undesirable precipitates when neutralized to an alkaline condition. Samples of this waste at a pH of 2.0 were found to be decontaminated with a dF greater than $10^4$ when phosphate was added and they were passed through beds of crushed bauxite. At a pH of less than 1.0 bauxite removes none of the plutonium. A dF of about $10^2$ was obtained with a bauxite bed when no phosphate was added to the waste. The mechanism of the reaction involved is not known but tests indicate that Pu occurs as an anion in these acid wastes.

L. P. Bupp

Manager
Chemical Research and Development

LP Bupp:jd

VISITS TO HANFORD WORKS

| Name | Dates of Visits | Company or Organization Represented and Address | Reason for Visit | HW Personnel Contacted | Access to Restricted Data |
|---|---|---|---|---|---|
| C. Vogler | 8/1/ | Argonne National Lab. Lemont, Illinois | Discuss problems of decontaminating reactor components. | RE Burns | Yes |
| E. J. Jungmann | 8/4/ | Midland Drilling Co. Walla Walla, Wash. | Discuss rotary core sampler now available also rotary drilling techniques. | DJ Brown<br>RE Brown<br>JR Raymond<br>WH Bierschenk | No |
| R. F. Makens | 8/6/ | Michigan College of Mining & Technology Houghton, Michigan | To obtain a broad view of Hanford's disposal practices. | JF Honstead | Yes |
| V. L. Stevens | 8/7/ | Boyles Brothers Drilling Company Salt Lake City, Utah | Discuss geological aspects of construction of caisson and laterals for tank leak detectors. | RE Brown | No |
| T. Lenahan | 8/7-8/ | Halliburton Oil Well Cementing Company Duncan, Oklahoma | Discuss general field waste disposal to the ground, policies and procedures. | RE Brown<br>DW Pearce | No |
| R. Schuman | 8/20/ | Phillips Petroleum Arco, Idaho | Electrodeposition of Pu. | R Ko<br>AC Leaf<br>RJ Brouns | No |
| J. Kosaftis, | 8/19-21/ | Applied Research Lab. Glendale, Calif. | Consultation and inspection of B-L Spectograph. | HJ Anderson | No |
| L. T. Corbin<br>M. T. Kelley | 8/21-22/ | Oak Ridge National Lab. Oak Ridge, Tennessee | Discuss analytical methods and instrumentation. | RJ Brouns<br>HJ Anderson<br>EW Christopherson<br>DL Reid | Yes |

VISITS TO OTHER INSTALLATIONS

| Name | Dates of Visits | Company Visited and Address | Reason for Visit | Personnel Contacted | Access to Restricted Data |
|---|---|---|---|---|---|
| D. R. Kalkwarf | 8/1/ | Brookhaven Nat'l. Lab. Upton, New York | Discuss inactivation of solutes in irradiated aqueous solutions. | HJ Curtis | No |
| | 8/4-8/ | Gordon Research Conf. New Hampton, N. H. | Attend Meeting | LJ Augensteine | No |
| A. S. Wilson<br>M. T. Walling, Jr. | 8/11-15/ | Harwell, England | Technical discussions on solution chemistry of ruthenium. | JM Fletcher & Associates | No |
| K. H. Hammill | 8/5-7/ | B. D. Bohna Co. San Francisco, Calif. | Consultation regarding High Level Radiochemistry Facility | JJ Brezina | No |
| W. W. Marshall | 8/11-15/ | Denver Research Inst. Denver, Colorado | Technical consultation on research facilities. | C Prien | No |
| M. C. Lambert | 8/13-15/ | Denver Research Inst. Denver, Colorado | Attend 7th Annual Conference Industrial Applications of X-Ray Analysis | | No |
| R. E. Brown<br>W. H. Bierschenk<br>J. R. Raymond | 8/19/ | Storey Drilling Co. Prosser, Wash. | Discuss new air drill used by L. J. Storey for well drilling. | H Zoda | No |
| D. W. Pearce | 8/18-31/ | Office of European Economic Cooperation, Mol, Belgium | Aid in advising on technical problems relating to planning Mol installation. | Dr. Eric Haeffner | No |

## BIOLOGY OPERATION

A. There were no significant changes in personnel or organization during August.

B. TECHNICAL ACTIVITIES

FISSIONABLE MATERIALS - 2000 PROGRAM

### BIOLOGICAL MONITORING

#### Atmospheric Contamination

Concentrations of $I^{131}$ in thyroid glands of jack rabbits were about the same as one year ago. Values were as follow:

| Collection Site | µc/g Thyroid Average | µc/g Thyroid Maximum | Trend Factor |
|---|---|---|---|
| Prosser Barricade | $2 \times 10^{-3}$ | $3 \times 10^{-3}$ | + 2 |
| Wahluke Slope | $8 \times 10^{-4}$ | $1 \times 10^{-3}$ | - 2 |
| Four Miles SW of Redox | $5 \times 10^{-4}$ | $8 \times 10^{-4}$ | - 2 |

Fission products were present in tissues of rabbits in the following amounts which were about the same as one year ago:

| Sample Type | µc/g Tissue Average | Trend Factor |
|---|---|---|
| Bone | $5 \times 10^{-5}$ | - |
| Feces | $4 \times 10^{-5}$ | - |
| Liver | $7 \times 10^{-6}$ | - |
| Muscle | $6 \times 10^{-6}$ | - |

#### Columbia River Contamination

Contamination levels for beta emitters are as follow:

| Sample Type | Collection Site | µc/g wet wt. tissue Average | Trend Factor |
|---|---|---|---|
| Minnows (entire) | Hanford | $4 \times 10^{-3}$ | - |
| Whitefish flesh | F-1 | $1 \times 10^{-3}$ | Not sampled in July |
| Whitefish flesh | Ringold | $7 \times 10^{-4}$ | " |

#### Effect of Reactor Effluent on Aquatic Organisms

During the past eleven weeks effluent from the 100-F reactor at a strength of 3 per cent was monitored with juvenile rainbow trout. The adverse effect

of this concentration of effluent has been greater than was anticipated from previous monitoring and might well be associated with the unusually high temperature of Columbia River water this year.

A test which has been under way to determine the usability of well water for toxicity studies at the Aquatic Biology laboratory has thus far served only to show of mechanical difficulties in the pumping and supply system. It is hoped that these conditions are now corrected so that the test can be re-run under more favorable circumstances.

## BIOLOGY AND MEDICINE - 6000 PROGRAM

### METABOLISM, TOXICITY, AND TRANSFER OF RADIOACTIVE MATERIALS

#### Phosphorus

Equipment and techniques are being revised to measure the change in turnover rate of $P^{32}$ in trout under different temperature conditions.

Partial evaluation of data obtained in the rat on distribution and retention of $P^{32}$ in the ovary as compared to bone indicates that irradiation of genetic tissue might well prove more critical than irradiation of bone. Radiation dose to the rat ovary during chronic exposure is about one-third that to the bone, assuming uniform distribution of $P^{32}$ in ovary and bone. Distribution of $P^{32}$ in the ovary, as indicated by autoradiographs is very non-uniform, but the effect of this non-uniformity in terms of irradiation dose to genetic material remains to be evaluated. With regard to effects on the present MPC there is the question of extrapolation to the human, and the further complication that the present MPC is rather arbitrarily established without direct reference to the radiation dose to bone.

#### Zinc

Six-day-old rats retained after 24 hours 95 per cent of an intragastrically administered dose of $Zn^{65}$. The liver contained 23 per cent of the dose. Highest concentration of $Zn^{65}$ was in the liver which exceeded the concentration in pancreas by a factor of 3, in bone by a factor of 4, and in lung and spleen by a factor of 5. Adult rats, by comparison, show a 24-hour retention of about 12 per cent of fed $Zn^{65}$.

#### Strontium

The first segment of a study to compare the uptake of $Sr^{90}$ in fish from water and from food was completed during the month. Results are not yet available since all samples are now being stored pending secular equilibrium.

A total of ten pigs, ranging in age from 75 days to 2½ years, have received single oral doses of $Sr^{90}$ and the excretion pattern has been followed for 10 to 15-day periods. Preliminary results of the excretion pattern and of tissue concentration of $Sr^{90}$ at autopsy are as follows:

Urine activity peaked at 3 to 4 days, feces at 5 to 6 days after dosing in the adult pigs.

Bone had the highest tissue activity in all ten animals, with 75-day-old animals having 12 per cent, 115-day-old 28 per cent, and 2½-year-old pigs having 4 per cent of the administered dose in bone.

The pituitary gland in 9 out of 10 animals showed a tissue concentration generally higher than any other soft tissue.

The 75-day-old animals were cross-bred pigs from a Palouse-Miniature swine cross, which could explain the difference in uptake as compared to the 115-day-old group which were pure Palouse strain. This possibility will be investigated.

Effect of variation in the Sr/Ca ratio on uptake of $Sr^{90}$ and $Ca^{45}$ was evaluated with bean plants grown in nutrient solutions. In one series the sum of the cations was held constant by increasing Sr as Ca decreased. In the other no carried Sr was added as Ca concentrations were decreased.

Plant yield was reduced below control values only in solutions containing Sr/Ca ratios of one or more, indicating that under these conditions strontium interfered with Ca utilization.

Uptake of $Ca^{45}$ and $Sr^{90}$ was not affected by changing ratios of Sr/Ca. Only when the concentration of cations decreased, by decreasing Ca, was the uptake of $Ca^{45}$ and $Sr^{90}$ increased. The greatest relative increase in $Ca^{45}$ concentration was in leaves whereas the greatest relative increase in $Sr^{90}$ concentration was in roots. These changes were reflected in OR (observed ratio) $[(Sr^{90}/Ca^{45})_{plant}/(Sr^{90}/Ca^{45})_{solution}]$ values and showed a selective translocation of $Ca^{45}$ as compared with $Sr^{90}$.

Bean, barley, and radishes grown successively on soil treated with $CaCl_2$, $CaSO_4$, and $CaCO_3$ showed no changes in OR values which were statistically significant. The average values suggest that $CaCO_3$ may be slightly more effective in depressing the OR than is $CaCl_2$ or $CaSO_4$.

Plants grown on soils deficient in calcium respond most favorably, as judged by depression of $Sr^{90}$ uptake, to gypsum or lime treatment. Accompanying the depressed $Sr^{90}$ uptake there is also an increased yield of plant matter. In a test with Cinebar soil nitrogen concentration was varied to change yield while calcium was held constant. Under these concentrations of $Sr^{90}$ in plant material was unaffected by changes in yield indicating that accumulation of $Sr^{90}$ is proportional to growth but concentration of $Sr^{90}$ is independent of yield.

Final harvests of barley from milliacre plots, contaminated with 1 and 10 mc $Sr^{90}$/plot four years ago, show $Sr^{90}$ concentrations of $2 \times 10^{-3}$ and $7 \times 10^{-3}$ microcuries per gram vegetation, respectively, from 1 and 10 mc plots. Slightly higher uptake was noted in cultivated compared to uncultivated plots. Lack of proportionality to initial contamination will be investigated.

Iodine

The Q/D (ratio of radioiodine in the thyroid to the quantity fed daily) of the experimental sheep for the month of August shows a general increase due to terminal stages of lactation and beginning weaning of lambs and borderling biological effect of $I^{131}$ at 1.5 μc/day.

Breeding of the eleven adult Palouse swine on chronic $I^{131}$-feeding regimens and of the six control animals was initiated this month.

A survey of the pig thyroid monitoring instrument was performed by a Radiological Physics Fellow. Various sized $I^{131}$-spiked pellets, ranging from one to seventy-five microcuries, were checked and the CM/μc noted. It was found that over this range the counts did not vary appreciably, tending to decrease slightly at the higher levels.

Blood volume determinations in Palouse swine of different ages and weights were made using radio-iodinated serum albumin. Determinations were made on two different age groups; i.e., six animals between 7 and 8 months of age and five animals between 2 and 4 years of age. The blood volume in ml of blood per 100 grams of body weight was 6.5 and 5.3 ml, respectively, for the two groups. These results are slightly higher than those reported by Hansard, et al., in their work in which they used $P^{32}$-tagged red cells for determing blood volumes.

Tungsten

Twenty-four hour retention of intragastrically administered $W^{185}$ was 2.5 per cent of dose; somewhat higher than previously reported. Thirty days after administration, 0.25 per cent of the dose remained in the rat, of which 67 per cent was in the skeleton and 12 per cent in the spleen. The biological half-life in the spleen was approximately 40 days; in the bone, approximately 20 days.

Plutonium

Experiments were performed to determine the effect of route of administration of $CaNa_3$ DTPA on its effectiveness in prefenting the deposition of plutonium administered to rats as the citrate, one hour previous to DTPA treatment. Three-tenths millimole Ca $Na_3$ DTPA was administered intragastrically, intravenously, intramuscularly, intraperitoneally, or subcutaneously. Plutonium retention was measured in femur, liver, kidney, spleen, and remaining carcass after four days. Excreta were collected, but have not yet been analyzed. The intragastric route was markedly less effective than other routes with respect to all tissues analyzed. The other routes were of comparable effectiveness with intravenous administration having a slight edge. Total retention of plutonium in the intravenously treated animals was 8.6 per cent of the administered dose.

Radioactive Particles

Mice were treated with aerosols of NaCl, atropine, $H_2S$, $CO_2$, alpha-naphthyl-thiourea, $CO_2$, $SO_2$, $AgNO_3$ or $H_2O_2$ at intervals for two weeks after pulmonary deposition of $Ru^{106}O_2$ particles. One month later the treated mice showed body burdens of $Ru^{106}$ half those of the controls. These agents show promise of hastening the removal of inhaled insoluble particles. The experiments will be repeated using both mice and dogs.

Preparations for exposure of dogs to $Pu^{239}O_2$ dusts are nearly completed.

Fallout

Vegetation samples collected during June from stations in Washington, which are representative of different environmental conditions, contained measurable amounts of $K^{40}$, $Cr^{147}$, $Cr^{144}$-$Pr^{144}$, $Zr^{95}$-$Nb^{95}$, $Ru^{103}$, $Ru^{106}$-$Rh^{106}$, and $Ba^{140}$-$La^{140}$.

Relative Biological Effectiveness

RBE values of 0.9 to 1.0 were obtained for $H^3/P^{32}$ on non-dividing yeast cells, measured by per cent of cells killed. These are identical with values obtained with growing cells and suggest that neither growth nor the more complex medium associated with growth affect the RBE value.

Tests for Ability to Sense Ionizing Radiation

An experiment has been initiated to test the ability of D. melanogaster to avoid areas of radiation. A two-sided lucite cage permits flies to move freely from areas of radiation to areas free of radiation. Flies which show an avoidance reaction will lay their eggs on the non-radiation side and they should have a selective advantage over flies not detecting radiation since eggs laid in the radiation field will largely be killed. With time, a sensitive population should develop if there are even a few flies which are initially able to sense and avoid the radiation field.

HA Kornberg

Manager
BIOLOGY OPERATION

HA Kornberg:es

C. OFF SITE VISITS AND HLO VISITORS

| Name | Dates of Visits | Company or Organization Represented & Address | Reason for Visit | H.W. Personnel Contacted | Access to Rest'd. Data | Areas, Buildings Visited |
|---|---|---|---|---|---|---|
| **VISITS TO HANFORD WORKS** | | | | | | |
| A. Josephy | 8/5 | Time Magazine | Schedule photos | Biol. Mgrs. | No | 100-F, Biology |
| Army Medical Reserve Corps (35) | 8/5-6 | U.S. Army | Tour | Clarke, George, Foster | No | " , 146-FR 141-M |
| Col. Bach, Profs. Parker & Orlein | 8/5 | Reed College | Tour | Clarke, Foster | No | " " |
| Mr. Snyder | 8/6 | AEC, Wash. D. C. | Tour | George | No | " " |
| Croswell Henderson | 8/6-7 | US Public Health, Cincinnati | Discuss research problems. | Foster | No | " " |
| Dr. Alan Beetle | 8/18 | U. of Wyoming | Study kinds and distribution of Artemesia | Pendleton | No | " " |
| Dr. Dennis Boddy | 8/22 | Columbia Basin Coll. | Tour | Pendleton | No | " " |
| Dr. Walter Woodbury | 8/26 | U. of Utah | Tour | Pendleton | No | " " |
| Dr. Harvey and Dr. Peterson | 8/28 | Montana State Univ. | Tour | Clarke, Hungate | No | " " |
| Dr. J. R. Gabel | 8/28 | U. of West Virginia | Tour | Hungate | No | " " |
| J. Cooke | 8/28-29 | Time Magazine | Take photos | L-4 Mgrs. | No | " " |
| **VISITS TO OTHER INSTALLATIONS** | | | | | | |
| RF Palmer | 8/10-15 | Burlington, Vermont | Present paper | Int'l. Congress | No | - |
| MF Sullivan | " | " " | " " | " " | " | - |
| | | and Brookhaven Lab | Discuss research | | " | " |
| RC Thompson | " | Burlington, Vermont | Present paper | Int'l. Congress | " | - |
| JJ Davis | " | " " | " " | " " | " | - |
| DG Watson | " | " " | " " | " " | " | - |
| WJ Bair | 8/10-18 | " " | " " | " " | " | - |
| | | and Rochester, N.Y. | Discuss NAS work | Stannard | " | - |
| N.L. Dockum | 8/10-21 | Burlington, Vermont and Wash. D. C. | Present papers | Int'l. Congress Biol. Photo. Assoc. | " | - |
| W.J. Clarke | 8/9-23 | Burlington, Philadelphia, Washington, D.C. | Attend Mtg. Present paper Discuss research | Int'l. Congress AMVA - Philadelphia Armed Forces Path. Inst. (Dr. Horovat) | " " | " " |
| F. P. Hungate | 8/10-19 | Burlington, Vermont Beltsville, Md. | Present paper Discuss research | Int'l. Congress Reitemier, Menzel | " | - |
| R. T. O'Brien | 8/7-15 | U. of Rochester Burlington, Vermont | Discuss research Present paper | Rothstein Int'l. Congress | " | - |

D. Lectures

a. Papers presented at meetings

W. J. Bair, "Hazards of Inhaled Radioactive Particles," August 11, 1958, International Congress of Radiation Research, Burlington, Vermont.

J. J. Davis, "Radioisotopes in Columbia River Organisms," August 12, 1958, International Congress of Radiation Research, Burlington, Vermont.

R. F. Palmer, "Effect of Dietary Calcium Level on the Metabolism of $Sr^{90}$ and $Ca^{45}$ in the Mature Rat," International Congress of Radiation Research, August 12, 1958, Burlington, Vermont.

M. F. Sullivan, "Radiation Effects on Nucleic Acid Metabolism in the Gastrointestinal Tract of Rats," August 12, 1958, Burlington, Vermont, International Congress of Radiation Research.

R. C. Thompson, "TheSignificance of Calcium in the Evaluation of the $Sr^{90}$ Fallout Hazard," August 12, 1958, International Congress of Radiation Research, Burlington, Vermont.

N. L. Dockum, "Detection of Plutonium Contamination in Humans by the Autoradiographic Method," August 12, 1958, International Congress of Radiation Research, Burlington, Vermont.

F. P. Hungate, "Relative Effectiveness of Beta Radiations on Cellular Mechanisms," August 12, 1958, International Congress of Radiation Research, Burlington, Vermont.

R. T. O'Brien, "Post-Irradiation Release of Phosphorus by Yeast," August 12, 1958, International Congress of Radiation Research, Burlington, Vermon

D. G. Watson, "Effects of Chronic Feeding of Phosphorus-32 on Rainbow Trout," August 12, 1958, International Congress of Radiation Research, Burlington Vermont.

N. L. Dockum, "Autoradiographic Techniques in Biological Research," August 18, 1958, Washington D. C., Biological Photographers Association.

W. J. Clarke, "Studies in Radibiology", August 17, 1958, Am. Coll. of Vet. Toxicologists, Philadelphia, Pa.

b. Seminars

August 5 - M. F. Sullivan, W. J. Bair, D. G. Watson (Presented papers listed above)

August 6 - N. L. Dockum, F. P. Hungate (Presented papers listed above)

August 4 - W. J. Clarke - Radiation Tumorigenesis - (Radiological Physics Fellows)

E. Publications

a. HW Documents

Palmer, R. F. and M. F. Sullivan, "Effect of Intestinal Tract Irradiation on Serum Proteins of the Rat," Document HW-56414 (UNCLASSIFIED) June 17, 1958.

b. HW Documents (internal distribution)

Foster, R. F., "The Effect on Fish of Increasing the Temperature of the Columbia River," Document HW-54858 (SECRET) March 14, 1958.

c. Open Literature

Davis, J.J. and R. F. Foster, "Bioaccumulation of Radioisotopes Through Aquatic Food Chains," Ecology 39 (3) 530-35 (July 1958).

# OPERATIONS RESEARCH AND SYNTHESIS OPERATION MONTHLY REPORT

August, 1958

## ORGANIZATION AND PERSONNEL

There were no changes in personnel in August.

## OPERATIONS RESEARCH ACTIVITY

Work on the evaluation of the capital expenditure program was delayed due to vacations, trips and other commitments on the part of the study members. Normal activity on this program will be resumed early in September.

Work in connection with uranium pricing and HAPO input-output response simulation models was continued.

### CPD Control Study

The feasibility of using large material balance areas for accountability control coupled with adequate material control within these areas is being examined in the Z Plant. The combination of the Process Chemistry Operation (Tasks I, II and III) and the Product Recovery Operation (Dissolving, Metal Recovery, and Recuplex Extraction) appears to require 1) the adoption of an inventory procedure based on the LIFO (last in first out) principle for Product Recovery Feed Storage and 2) an internal material control system that provides information regarding process recovery according to both the type of material (slag and crucible, skull, fluoride sweeps, etc.) and the time period during which this material was generated.

The special study concerned with the frequency of bias corrections for accountability purposes based on results from the analytical laboratories is nearing completion. A report on this will be issued during September.

Work on the Z Plant Information Study has been primarily concerned with a detailed description of the casting and machining process as it now exists. At the same time considerable effort has been expended toward designing the logic of the process. This work was also somewhat hampered during the month due to other demands on the team members. A document integrating the meeting minutes and other materials prepared by team members will be issued soon (distribution to team members only) to provide them with an up-to-date record of all activities.

### Other

Personnel of the Standards Engineering Operation of IPD are presently checking the applicability of suggested inventory control models on a random sample of 100 IPD spare part items. Indications are that the formulas involved will greatly assist responsible personnel in setting inventory levels and minimizing

## STATISTICAL AND MATHEMATICAL ACTIVITIES FOR THE PRODUCT DEPARTMENTS

### Process Control (Fuels Preparation Department)

The proposal submitted to FPD personnel during July concerned with continuously experimenting about the region of current process operation in attempting to gradually approach an optimum set of operating conditions has been well received. A series of meetings with those concerned with setting up this "evolutionary method" of operation will begin in September.

### Process Experimentation (Fuels Preparation Department)

An experiment was designed to evaluate the effects of five process variables on total bond count of a fuel element, each variable having two levels assigned to it. Since it was not feasible to gather data at each of the 32 sets of conditions necessary in a full $2^5$ factorial, a one-half replicate was designed which permitted an evaluation of all main effects and first order interactions, the necessary degrees of freedom being furnished by replicating at each set of conditions. The resulting data were analyzed as requested. The replication within each cell suggested that a logarithmic transformation of the data would be necessary in order to attain homogeneity of variance and normality.

Further experimental data were analyzed to evaluate the effects of quenching methods on braze layer porosity.

Recommendations were given on the types of data to collect in order to determine the variables which might be related to abnormally large diameter growths of canned fuel elements.

### Production Tests (IPD and FPD)

A report was issued presenting the results of an analysis of dimensional distortion data from production test IP-95-A-79 MT. This test was primarily concerned with evaluating I and E fuel elements designed for use in BDF-sized process tubes. Measurements from control tubes filled with solid fuel elements were also available. The wide range of exposures associated with these tubes made the data particularly informative.

An analysis is being made of data from production test IP-120-A-94 FP. This test was run to compare the performance of ingot with low hydrogen dingot fuel elements.

### Final Product Specifications (CPD)

A recommendation was made that the existing tolerance limit statements used to demonstrate conformity of the final product to plutonium content specification be replaced by a procedure in which each individual part is accepted or rejected based on the measurements associated with that particular part. No action has been taken as yet in response to this proposal.

## OTHER STATISTICAL AND MATHEMATICAL ACTIVITIES

### Activities for Other Departments

Consulting services were provided to the Atmospheric Physics Operation during the scoping stage of an Air Force contract deposition and diffusion study. Such services will continue during the design, experimentation, and analysis stages of this study.

Statistical evaluation of follow-up studies on Radiation Protection Operation's Eastman versus duPont personal monitoring film evaluation program was initiated this last month.

Assistance in analyzing and presenting results of a PBM survey and in presenting industrial medical information for a business review were provided for the Relations and Utilities Operation.

### Activities within HLO

Consulting services were provided to personnel of the Employee Compensation Operation on the relative advancement rates of exempt employees with respect to their years of training in the different scientific and engineering disciplines.

A statistical analysis was made of film badge data which compared film density with neutron and with gamma exposure. A regression analysis was made on the data and a conversation ratio was developed between the two types of exposure. Also, the procedure was given for separating measurement error from process error in the analysis of film badge data.

## OFFSITE VISITS AND VISITORS

W. H. Bloodworth of the Operations Research and Synthesis Consulting Service in New York visited the group on August 19, 20 and 21 for a review of the operations research programs.

C. A. Bennett spent August 25 and 26 in Washington, D. C. discussing Washington Designated programs.

R. L. Basmann attended the Western Regional Meeting of the American Economic Association at Pullman, Washington on August 15.

W. L. Nicholson spent August 22 at the Argonne National Laboratory, Lemont, Illinois discussing computational techniques and specifically the workings of the SHARE organization, with Dr. Richard F. King and Dr. William Miller of the Applied Mathematics Division; August 25 in Washington, D. C. consulting on Washington Designated programs; August 26 to 28 attending the annual meeting of the Institute of Mathematical Statistics at Cambridge, Massachusetts; and August 29 discussing operations research and statistical problems with the Information Study Section of the General Electric Research Laboratory at Schenectady.

Carl C. Bennett

CAB:jbk

1238535

Carl A. Bennett, Manager
OPERATIONS RESEARCH
AND SYNTHESIS

PROGRAMMING OPERATION
AUGUST 1958

## A. FISSIONABLE MATERIALS - 2000 PROGRAM

### 1. Neptunium-237 Processing

Work was begun on the possibilities, timing, and costs of decontamination and recovery of irradiated and unirradiated neptunium-237 and plutonium-238. The neptunium could be recovered from existing separations plant process streams by rather simple and inexpensive equipment. The processing of the irradiated neptunium, on the other hand, will require special facilities. Investigation of provisions of small and special facilities in the Hot Semi-Works is being emphasized. An "A B C" type solvent extraction system with separate anion exchange beds for isolation, purification, and concentration of the two products appears most feasible at this stage of the study.

### 2. Power Reactor Fuel Processing

Work was continued on the study of facilities and costs involved in providing the required flexible power reactor fuel processing facilities in 221-U plant. Equipment suitable for dissolution of stainless steel, zirconium and aluminum clad fuel elements is required. With the establishment of Hastelloy-F as a suitable material of construction resistant to $HNO_3$-HF (Niflex process), facilities constructed of this material which could do the equivalent dissolution job of the Darex and Zirflex equipment were found to cost $1,100,000. As reported last month, such facilities for the Darex and Zirflex process combination would cost $3,000,000. (Both costs are study stage estimates.) By a moderate increase in costs the Hastelloy-F system could also be made flexible enough to provide for the operation of the Sulfex process which may be preferred for some fuels. Six cells in 221-U would be required for the Darex-Zirflex process equipment; three would be required for the Niflex process ($HNO_3$-HF process with or without facilities to provide for Sulfex).

These study stage estimates do not provide for head-end fuel element handling facilities, transport of fuel solutions to Redox or receiving facilities at Redox. Significant operating costs such as chemicals and waste storage have not yet been investigated.

## B. REACTOR DEVELOPMENT - 4000 PROGRAM

### 1. Plutonium Recycle Program

#### Plutonium Evaluation

Progress continued on the comparison of plutonium with uranium-235 as a source of uniform enrichment in uranium-238 reactor fuel. Previous comparisons which have shown plutonium to be a superior fuel (on the basis of providing a longer burnout, higher MWD/T) have employed a constant

and equal value of the factor, r, defined as the ratio of epithermal to thermal neutrons. The factor, r, is not only a function of the lattice geometry, but it is also dependent upon the particular isotopic composition and thus will change during an irradiation cycle. This restriction has recently been circumvented by the formulation of a factor, $\Lambda$, which may be identified with the ratio of the fuel mass to the moderator slowing-down power and which is an essentially fixed lattice parameter. The quantity $\Lambda$ is calculated using an IBM 650 program based on the following expression:

$$\Lambda_{(\tau)} = \frac{-\ln p\,(\tau)}{\Sigma_k N_k\,(\tau)\,(I_{ak} - I_{fk}\,\nu_k\,\epsilon p/k_\infty)}$$

where $N_k$ = concentration of the isotopes.

$I_{ak}$ and $I_{fk}$ are effective absorption and fission resonance integrals in kilobarns (in excess of the 1/v part) for each isotope.

$\nu_k$ = number of neutrons produced per fission in $k^{th}$ isotope.

$p$ = resonance escape probability

$k_\infty$ = multiplication constant

$\epsilon$ = fast fission factor

Since a numerical change in r results in a change in $\Lambda$, it is possible to hold $\Lambda$ approximately constant by varying r during any exposure calculation.

In comparing cases calculated to date with a constant r against the same cases calculated with a constant $\Lambda$, it has been found that the change in maximum attainable exposure varies from nearly zero to as much as 20 per cent.

The comparison of plutonium with uranium-235 as uniform enrichment in uranium-238 fuel at constant $\Lambda$ has again established the superiority (higher attainable MWD/T) of plutonium for two specific cases. These initial cases are biased in favor of plutonium since large loss factors were assumed.

Fuel Cycle Analysis

About 600 plots involving approximately 40,000 data points have been plotted with the IBM 702. The plots represent about 2/3 of the once through data which has been run with the IBM 650 during July and August and covers the following reactor variables:

Once-Through Reactor Parameters

| Temp. °C | $k_\infty/\epsilon$ | p | f | MW/T | Canning Cost $/#U |
|---|---|---|---|---|---|
| 80 | 1.112 | 0.9 | 0.8 | 10 | 15, 25, 50 |
| 200 | 1.10 | 0.9<br>0.7 | 0.95<br>0.80<br>0.60 | 15, 1<br>10, 0.5<br>5, 0.1 | 10, 20, 25 |
| 80<br>400 | 1.10 | 0.9<br>0.7 | 0.95<br>0.80<br>0.60 | 0.1<br>1.0<br>10 | 10, 20, 25 |
| 200 | 1.20<br>1.15<br>1.10 | 0.9<br>0.7 | 0.95<br>0.90<br>0.80<br>0.70<br>0.60 | 10 | 10, 20, 25 |

1. Plutonium value taken as $5 and $15/gram.
2. $k_\infty/\epsilon$ = multiplication constant/fast fission factor.
3. p = resonance escape probability.
4. f = thermal utilization factor.
5. MW/T = megawatts/ton of uranium fuel.

In addition, separations costs, on-line efficiency, and interest charged were varied with the following base cases:

| Temp. °C | $k_\infty/\epsilon$ | p | f | MW/T | |
|---|---|---|---|---|---|
| 200 | 1.10 | 0.9 | 0.8 | 10 | Separation Cost (2,4,8,12,16 and 20 $/#U) |
| 200 | 1.10 | 0.9 | 0.8 | 10<br>0.1 | On-line efficiency (54,72, and 81%) |
| 200 | 1.10 | 0.9 | 0.8 | 10<br>5<br>1<br>0.1 | Interest charge 15,12: 15,4: and 12,4 depreciating and non-depreciating capital, % |

The IBM 650 Recycle Economics program has been altered and debugged in order to eliminate an intermediate program required with the first IBM 702 plotter program. Several points have been rerun with the new Recycle Economics program for purposes of verification.

High Exposure Plutonium Requirements

The advantage of using high exposure plutonium from an external source in the PRTR to advance the date for demonstrating self-sustaining recycle has been recognized for some time. Specific amounts of plutonium required for

this purpose were estimated on the basis of the tentative PRTR fueling schedule. As a first step, a request was submitted to the AEC to make available to the Laboratories the plutonium from the fuel plates now being irradiated in the MTR and from the first PWR blanket. These sources would fill the reactor's estimated needs through FY-1961. The situation is being analyzed to determine what course should be followed to provide the needs beyond that since PRTR material will not become available in significant quantities until the last half of FY-1962.

PRTR Fueling Schedule

The detailed charge-discharge schedule for the first two years of PRTR operation was circulated for comment and has received general acceptance by all HLO components concerned. If the schedule is put into practice, the reactor will start up with 24 plutonium-aluminum fuel elements and 60 uranium dioxide fuel elements. It will operate at 60% level efficiency to allow ample shutdown time for experimental purposes. Additional plutonium-aluminum elements will replace original elements, one every eight days. The replaced elements will be alternately Pu-Al and $UO_2$ elements until there are 35 Pu-Al and 49 $UO_2$ elements in the reactor, after which fresh Pu-Al elements will replace fully exposed (50% burnup) Pu-Al elements, one every eight days. The 49 $UO_2$ elements will remain in the reactor for approximately two years when all the elements will begin to be replaced with uniformly plutonium-enriched $UO_2$ fuel elements. High exposure plutonium from an external source will be used in all the plutonium elements charged after the first six months' operation. The schedule allows 120 days cooling time for the discharged fuel and 30 days each for chemical processing and fuel element fabrication. The cooling time is now under review to determine the minimum time consistent with processing requirements. According to the proposed schedule, the PRTR will become almost self-sustaining late in FY-1963.

Fuel Examination

The study of costs, timeliness, and value of alternate methods of fuel core examination and inspection in support of the existing PRTR schedule was continued. Preliminary results indicated that facilities provided at 221-U will be prohibitively expensive and that cheaper and preferred facilities may be provided in 300 Area.

C. OTHER ACTIVITIES

1. Summer Institute on Nuclear Energy - Chemical Processing

The 1958 "Summer Institute on Nuclear Energy - Chemical Processing" program was completed on August 15. The program involved the presentation of lectures by forty speakers and the conduct of tours to twenty-four facilities which also required the services of forty persons acting as guides and tour speakers. In addition, about fifteen individuals had direct contact with the participants in the conduct of the problem assignments. With others involved in planning, direction, and assistance, it can be said that direct efforts of about one

hundred individuals were involved in this program. The written appraisals received from the participants indicates that the program met expectations and had been worthwhile.

W H. Reas

for Manager, Programming Operation

WH Reas:dl

VISITS TO HANFORD:

| Name | Dates of Visit | Company or Organization Represented and Address | Reason for Visit | HAPO Personnel Contacted | Access to Restricted Data | Bldgs. & Areas Visited |
|---|---|---|---|---|---|---|
| T. J. Connolly | 8/5-7/58 | Atomics International Canoga Park, California | To discuss plutonium fuel cycles and the PRTR. | JR Triplett | No | 300 - 328 |

VISITS TO OTHER INSTALLATIONS

| Name | Dates of Visit | Company Visited and Address | Reason for Visit | Personnel Contacted | Access to Restricted Data |
|---|---|---|---|---|---|
| G. J. Busselman | 8/25 - 8/29/58 | American Physical Society Vancouver, B. C. | Attend unclassified meeting of American Physical Society. | Dr..G.L. Pickard | No |
| E. A. Eschbach | 8/19 - 8/21/58 | General Electric Co. Schenectady, N. Y. | Attend discussion on reactor technology. | Ed Schmidt | No |
| J. R. Triplett | 8/22/58 | American-Standard Atomic Energy Division Mountain View, Calif. | Discuss RBU computer contract with ASAE. | E.J. Leshan | No |
| | 8/25/58 | General Electric Co. (APED) San Jose, California | Discuss special aspects of reactor technology with APED. | R.B. Richards | No |

# RADIATION PROTECTION OPERATION
# MONTHLY REPORT - AUGUST 1958

## A. ORGANIZATION AND PERSONNEL

On August 25, 1958, Victor M. Milligan was hired from the AEC Radiological Physics Fellowship Program into the Radiation Monitoring Operation. Mabel S. Matthews was reactivated on August 18, 1958. Louise S. Nunn terminated on August 8, 1958. Several transfers were effected during the month which included: Lester P. Rolph to IPD on August 1, 1958; Marion L. Thompson to Plutonium Metallurgy-HLO on August 4, 1958; Shara P. Bobo to Laboratory Auxiliaries-HLO on August 18, 1958; and W. D. Themar to Fuels Design-HLO on August 25, 1958. Leo J. Defferding and Rita M. Bernard were beneficially transferred within RPO.

## B. ACTIVITIES

No cases of plutonium deposition were confirmed through bioassay analyses in August. One case of localized overexposure to the skin resulted from a CPD employee being exposed to a contaminated glove which resulted in a dose of approximately 3.5 rads including 0.03 r to a small skin area.

Several potential exposure cases occurred in Hanford Laboratories when employees were exposed to air-borne plutonium contamination in the 231 and 325 Buildings. Exposure to concentrations up to $4 \times 10^{-8}$ μc Pu/cc occurred. Facial contamination up to 3,000 d/m resulted in one case. All of these exposure situations involved the rupture of plastic bags containing plutonium or discoveries of significant quantities of plutonium outside of process hoods. Body dose rates up to 5 r per hour were encountered following irradiation of materials in the Physical Constants Test Reactor.

Since distribution of the radiation exposure cards to all employees early in August, a total of 22 inquiries has been received and appropriately acknowledged. Of these 22, four requests for further information indicated minor errors in the total doses which were reported to the involved employees. The primary difficulty in these cases was that part of the working histories was as AEC or construction employees as well as General Electric employees.

Progress on the Shielded Personnel Monitoring Station continued at a satisfactory

Decrease in the Columbia River water flow from about 190,000 cfs to 100,000 cfs resulted in approximately proportional increases in the gross beta concentrations in the Columbia River. Similar increases were noted in the reactor areas and in Pasco-Kennewick area drinking water systems. Enough historical data has been accumulated to initiate a running yearly average of the fraction of the MPC contained in Columbia River drinking water. The annual average will be useful in evaluating potential hazards in drinking water since cyclic river fluctuations affect the monthly values significantly.

Very preliminary results in the aerial surveys made for regional evaluation purposes indicate no significant change between readings a short distance off the ground and at a five-hundred feet altitude except when flying in the vicinity of manufacturing plants or waste disposal sites. The 24th Semiannual Report to Congress contained a statement indicating the plan of the United States Geological Survey to conduct air-borne background radiation surveys of all major Atomic Energy Commission production sites, licensee reactor sites, and the Nevada Test Site. Contact was made with the local Commission office to ensure integration of our program with the USGS program where appropriate.

Comparison of the calibration data for the recently developed neutron badge indicated the possibility of substituting a normal radium-gamma calibration for the thermal neutron calibration as an interim procedure pending the arrival of the plutonium-berrylium source being calibrated by the National Bureau of Standards. The routine radium-gamma calibration data may also be used to minimize the number of calibrations which are necessary.

Initial investigations aimed at an improved method to obtain an estimate of the exposure dose to a badge film where high-level radiation doses are involved indicated that the use of X-ray techniques to measure the quantity of reduced silver on developed film is not fruitful. Other investigations are continuing.

Construction work was completed on the new acid addition facility at the Bioassay Laboratory. Recent difficulties in impurities in the acid were attributed to pipe joint compound and similar materials in the newly installed system. This has caused some slight process difficulties, but will decrease with time. Additionally, there appeared to be substantially increased iron and heavy metals in the acid being received from the vendor as compared to the acid tested last winter. Tests are in process to determine the possible necessity of securing additional vendors.

A leak test of pencils used in the new pulse pencil reader program was started with charging voltages of 20, 60, 200, and 300 volts. These voltages will cover the range for both regional and personnel monitoring for very high doses and dose rates.

Ten small Sievert chambers and a holder were received on a loan from the Naval Medical Center in Bethesda, Maryland. Studies are in progress to determine the potential uses of these small chambers by their increased sensitivity through the new pulse pencil reading technique.

The proposed comprehensive training program for industrial physicians was prepared for submission. An extensive review of the radiological training needs for HAPO was initiated.

[redacted]

Radiation Protection Operation had the only General Electric display at the Benton-Franklin County Fair on August 22, 23, and 24. The display entitled "Radiation Protection at Hanford" was visited by approximately 3,000 people and was continuously manned by Radiation Protection personnel. Appropriate publicity was obtained in Eastern Washington newspapers.

C. EMPLOYEE RELATIONS

No further progress was made on Regional Monitoring negotiations.

Placement or firm plans for the placement of 15 of the 23 exempt and nonexempt employees scheduled for ROF from Exposure Evaluation and Records Operation were completed. This number increased to 15 from 12 last month. A total of eight employees remains to be placed.

There were two medical treatment injuries for a frequency of 0.87. No security violations occurred during the month.

Two suggestions were submitted by RPO personnel. Two suggestions were received for evaluation and one was completed. No awards were made to RPO employees.

D. SIGNIFICANT REPORTS

HW-57294 - "Monthly Report - August 1958, Radiation Monitoring Operation" by A. J. Stevens.

Undoc. - "Inventory of Radioactive Liquid Wastes to Active Disposal Sites - April, 1958" by R. M. Bernard.

HW-56993 - "Regional Monitoring Activities, July, 1958" by B. V. Andersen.

Undoc. - "Inventory of Radioactive Liquid Wastes to Active Disposal Sites - May, 1958" by R. M. Bernard.

VISITS TO HANFORD WORKS

| Name | Dates of Visits | Company or Organization Represented & Address | Reason for Visit | HW Personnel Contacted | Access to Restricted Data | Areas and Buildings |
|---|---|---|---|---|---|---|
| Dr. W. Parker<br>Dr. K. F. Oerlein<br>Lt. Col. S. A. Bach | 8/5/58 | Reed College Portland, Oregon Education Officer Hdqtrs. AFSWP Washington, D. C. Hdqtrs. Surgeon AFSWP (MC-U.S.A.) Washington, D. C. | Visited RPO facilities for planning of AFWSP schedules for next year. | AR Keene<br>HA Meloeny<br>RW Meisinger | None | 3745<br>3746<br>3705:300 |

VISITS TO OTHER INSTALLATIONS

| | | | | | | |
|---|---|---|---|---|---|---|
| J. W. Vanderbeek | 8/1/58 | Washington State Board for Vocational Education, Vocational Rehabilitation Division, Seattle, Washington | Consult with specialist on employee working conditions | Dr. L. M. Farner | | No |
| A. R. Keene | 8/11/58 | State Dep't. of Public Health, Seattle, Washington | Confer with representatives of Columbia River Advisory Group | Robert Stockman and Staff | | No |

REGIONAL MONITORING - RESULTS (July 27 - August 24, 1958)

| Sample Type and Location | Activity Type | Monthly Average | Units* | Trend** Factor |
|---|---|---|---|---|
| **Drinking Water** | | | | |
| 100-F Area | Isotopic | 1.0 | % $MPC_{GI}$ | +2 |
| Separations Areas | Total Beta | $1.4 \times 10^{-7}$ | µc/cc | -- |
| Pasco | Isotopic | 0.3 | % $MPC_{GI}$ | -- |
| Kennewick | Isotopic | 0.2 | % $MPC_{GI}$ | +3 |
| Richland | Total Beta | $< 3.0 \times 10^{-8}$ | µc/cc | -- |
| **Columbia River Water** | | | | |
| Above 100-B Area | Total Beta | $< 3.0 \times 10^{-8}$ | µc/cc | -- |
| 100-F Area | Isotopic | 2.5 | % $MPC_{GI}$ | +2 |
| Hanford Ferry | Total Beta | $3.0 \times 10^{-5}$ | µc/cc | +2 |
| Pasco | Isotopic | 0.7 | % $MPC_{GI}$ | +2 |
| McNary Dam | Total Beta | $3.2 \times 10^{-7}$ | µc/cc | -- |
| Vancouver, Washington | Total Beta | $1.5 \times 10^{-7}$ | µc/cc | -- |
| **Waste Water** | | | | |
| Outlying Test Wells | Total Beta | $8.7 \times 10^{-7}$(max) | µc/cc | -- |
| Reactor Effluent Retention Basins to River | Total Beta | 18,000 | curies/day | -- |
| **Atmosphere** | | | | |
| Gross Dose Rate - | | | | |
| Separations Areas | Beta-gamma | 0.7 | mrad/day | -- |
| Residential Areas | Beta-gamma | 0.7 | mrad/day | -- |
| I-131 Separations Areas | I-131 | $4.5 \times 10^{-13}$ | µc/cc | -- |
| I-131 Separations Stacks | I-131 | 4.5 | curies/week | -- |
| Active Particles - Project | -- | 7.9 | ptle/100 $m^3$ | -- |
| Active Particles - Environs | -- | 7.0 | ptle/100 $m^3$ | -- |
| **Vegetation** | | | | |
| Separations | I-131 | $4.0 \times 10^{-6}$ | µc/gm | -- |
| Residential | I-131 | $< 1.5 \times 10^{-6}$ | µc/gm | -2 |
| Eastern Washington and Oregon | I-131 | $< 1.5 \times 10^{-6}$ | µc/gm | -- |
| Fission Products less I-131 - Wash. and Ore. | Beta | $4.6 \times 10^{-5}$ | µc/gm | -2 |

* The % $MPC_{GI}$ is the percent of the maximum permissible limit for continuous occupational exposure to the gastrointestinal tract calculated from drinking water limits.

** The trend factor shows the n-fold increase (+) or decrease (-) from last month, where values of n less than 2 will not be noted.

## EXPOSURE EVALUATION AND RECORDS

### Exposure Incidents Above Permissible Limits

| | Whole Body | Localized |
|---|---|---|
| August | 0 | 1 |
| 1958 to Date | 4 | 9 |

### Gamma Pencils

| | Pencils Processed | Paired Readings 100-280 mr | Paired Readings Over 280 mr | Lost Readings |
|---|---|---|---|---|
| August | 36,808 | 41 | 8 | 0 |
| 1958 to Date | 346,086 | 297 | 44 | 20 |

### Beta-Gamma Film Badges

| | Badges Processed | Readings 100-300 mrads | Readings 300-500 mrads | Readings Over 500 mrads | Lost Readings | Average Dose Per Film Packet mrad(ow) | Average Dose Per Film Packet mr(s) |
|---|---|---|---|---|---|---|---|
| August | 10,818 | 624 | 45 | 8 | 34 | 3.13 | 13.84 |
| 1958 to Date | 156,736 | 6,001 | 221 | 61 | 327 | 2.99 | 9.63 |

### Slow Neutron Pencils

| | Pencils Processed | Paired Readings 4-12 mrem | Paired Readings Over 12 mrem | Lost Readings |
|---|---|---|---|---|
| August | None | | | |
| 1958 to Date | 25,880 | 297 | 94 | 8 |

### Fast Neutron Film Badges

| | Badges Processed | Readings Above 50 mrem | Lost Readings |
|---|---|---|---|
| August | 681 | 0 | 0 |
| 1958 to Date | 8,710 | 11 | 7 |

### Bioassay

| | August | 1958 to Date |
|---|---|---|
| Plutonium: Samples Assayed | 971 | 9,722 |
| Results above $2.2 \times 10^{-8}$ μc/sample | 34 | 316 |
| Fission Product: Samples Assayed | 980 | 10,088 |
| Results above $3.1 \times 10^{-5}$ μc FP/sample | 1 | 22 |
| Uranium: Samples Assayed | 354 | 2,597 |
| Confirmed Plutonium Deposition Cases | 0 | 15* |

*Bringing all-time HAPO total to 227.

## Uranium Analyses

| Sample Description | Following Exposure Units of $10^{-9}$ µc U/cc | | | Following Period of No Exposure Units of $10^{-9}$ µc U/cc | | |
|---|---|---|---|---|---|---|
| | Maximum | Average | Number Samples | Maximum | Average | Number Samples |
| Fuels Preparation | 8.2 | 1.8 | 76 | 17 | 3.0 | 30 |
| Hanford Laboratories | 31 | 5.3 | 31 | 58 | 9.3 | 13 |
| Chemical Processing | 60 | 8.0 | 96 | 34 | 4.1 | 96 |
| Chemical Processing* | - | - | - | - | - | - |
| Special Incidents | 0 | 0 | 0 | 0 | 0 | 0 |
| Random | 0 | 0 | 0 | 0 | 0 | 0 |

*Samples taken prior to and after a specific job during work week.

| Thyroid Checks | August | 1958 to Date |
|---|---|---|
| Checks Taken | 0 | 25 |
| Checks Indicating >0.01 µc | 0 | 0 |

| Hand Checks | | |
|---|---|---|
| Checks Taken - Alpha | 34,247 | 357,466 |
| - Beta-Gamma | 27,957 | 293,428 |

| Skin Contamination | | |
|---|---|---|
| Plutonium | 43 | 231 |
| Uranium | 9 | 59 |
| Fission Product | 56 | 462 |

## CALIBRATIONS

| Portable Instruments | Number of Units Calibrated | |
|---|---|---|
| | August | 1958 to Date |
| CP Meter | 950 | 7,677 |
| Juno | 330 | 2,604 |
| GM | 1,352 | 10,590 |
| Other | 208 | 1,766 |
| Total | 2,840 | 22,637 |
| **Personnel Meters** | | |
| Badge Film | 1,252 | 9,236 |
| Pencils | 1,488 | 29,075 |
| Other | 529 | 3,007 |
| Total | 3,269 | 41,358 |
| Miscellaneous Special Services | 924 | 6,372 |
| Total Number of Calibrations | 7,033 | 70,367 |

A R Keene

Manager
RADIATION PROTECTION

AR Keene:kc

# LABORATORY AUXILIARIES OPERATION MONTHLY REPORT - AUGUST, 1958

## GENERAL

Safety performance of the Operation was considered satisfactory. There were no major injuries; the minor injury frequency rate was 3.69 per cent.

The absenteeism rate was 3.86 per cent, which is about average experience.

There were no security violations charged to the Operation.

## TECHNICAL SHOPS OPERATION

Total productive time for the month was 11,171 hours. The total shop work backlog is 15,568 hours of which 50% is required in the current month, with the remainder distributed over a three month period. Overtime worked during the month was 1.2% (209 hours) of the total available hours.

| Distribution of time was as follows: | Man Hours | % of Total |
|---|---|---|
| Fuels Preparation Department | 1061 | 9.5 |
| Irradiation Processing Department | 1151 | 10.3 |
| Chemical Processing Department | 893 | 8.0 |
| Hanford Laboratories Operation | 7912 | 70.9 |
| Construction Engineering Operation | 38 | .3 |
| Miscellaneous | 116 | 1.0 |

A sharp decline in customer requests for emergency service resulted in the working of a nominal amount of overtime. The backlog decreased approximately 13% and currently stands at 5 crew weeks. This is still on the high side of what is considered optimum backlog, but does permit the shops to generally offer reasonable delivery dates.

In line with the planned machine tool replacement program, appropriation requests were submitted covering the items to be replaced this fiscal year. Additional items requested included a jigmill, vertical shaper, and a small openside planer. Acquisition of these machine tools will permit the expeditious completion of work now being accomplished by time-consuming methods.

## RADIOGRAPHIC TESTING OPERATION

A new record of activity for the Radiographic Testing Operation was achieved this month. A total of 9,493 tests were made, of which 1,960 were radiographic exposures (including X-ray and Gamma-ray) and 7,533 were supplementary tests. The supplementary test work included dimensional measurements (micrometric and radiographic layout), eddy current, leak detection, penetrant, and ultrasonic (thickness measurements and flaw detection).

Reflected in the increased number of tests, the feet of material examined and the number of pieces examined were also significantly higher than in previous months. The feet of material examined amounted to 12,311 feet; the number of pieces examined amounted to 3,384 pieces. Work was done for 17 different organizational components, representing most of the operating departments and service organiations. A total of 19 reports were issued, detailing test findings, with conclusions and recommended action. Radiographic Testing Operation was consulted on 32 different occasions for advice and information regarding general testing theory and applications for other than the jobs tabulated in Part II.

The MTR fuel plate program for the Arco Reactor was completed this month. Shipment of the last of the fuel plate assemblies was made in the middle of the month. Radiographic Testing Operation assisted in this program by providing complete radiographic service for core examination, core location, finished plate examination, and welding integrity on the control assemblies. News releases on August 20th reported the first successful operation of a reactor on plutonium fuel.

With the completion of the MTR fuel plate program it was possible for Radiographic Testing Operation to return to more normal shift operation. Return to the regular XYZ shift avoided any possibility of conflict in scheduling work involving radiation monitoring.

It would appear that the radiation parameters for the radioactive isotope application investigating rotting of power poles have been established. Fixing of the energy level required will permit this work to proceed. Considerable interest in the method is indicated from contacts with the Forestry Service and news agencies.

Priority work was done on a plutonium weapons component. Use was made of the 2 mev Van de Graaf to obtain satisfactory radiographs. The work was done in a 48-hour period.

Testing Statistics

| Component | No. of Tests | Ft. of Weld or Material | No. of Pieces | Description |
|---|---|---|---|---|
| A. CPD | 41 | 43 | 14 | SS ammonia scrubbers, 26" vacuum receiver tank for internal corrosion. |
| B. CEO | 1302 | 1989-1/2 | 1240 | 316 SS, Sch. 40 welders coupons. SS recirculating gas loop-AEC 160. Halogen snifter tests and radiographic interpretations on PRTR containment vessel. |

| Component | No. of Tests | Ft. of Weld or Material | No. of Pieces | Description |
|---|---|---|---|---|
| C. HLO | 7994 | 10055-1/2 | 1915 | UO,Zr. clad fuel elements, enriched Zr. clad fuel elements, MTR Zr. Capsules, U-238-Al castings, MTR cores, core location, finished plates, control rods and shim assemblies. Pu-Al fuel rods in Zr., 3", 1.2", 2.212", 1.802" and .750" O.D. Zircaloy tubing. Zirconium billets. |
| D. IPD | 24 | 18 | 13 | Corrosion build-up on affluent and effluent lines, 105-D. SS U bend samples for stress cracks. |
| E. R&U | 132 | 205 | 202 | Linemen climbers, Isotopic calibration for power pole rot survey. |
| TOTALS | 9493 | 12,311 | 3384 | |

## FACILITIES ENGINEERING OPERATION

### Project Activity

The attached monthly project report covers the individual project activity.

Following is a summary of project work:

There were 22 authorized projects at month end with total authorized funds of $4,747,300. The total estimated project cost of these projects is $8,923,800. One project was completed during the month. One project is awaiting AEC authorization. Project proposals for nine new projects are in preparation.

### Engineering Services

| Title | Status |
|---|---|
| Modification of Elevator, 327 Building | Security Fire Door Company has been awarded the contract for this work. |
| Alterations to Room 313, 3706 Building | Work is complete with minor exceptions. |
| Resistance Seam Welder, 325 Building | Work completed. |
| Clean Up West End of 314 Building | Construction Operation is working on removal. Job is essentially complete. Minor work items remain. |

| Title | Status |
|---|---|
| Installation of New Hood, Lab 14-A, 329 Building | Hood fabrication is approximately 20% complete. |
| Fabricate and Install XY Manipulator in Metallographic Cell | Work is approximately 50% complete. |
| Sprinkling System for Aquatic Biology Building - 100-F | Job is complete. |
| Extend Annunciator System - 1706-KE Building | Installation work remains to be performed. |
| Inspect and Make Recommendations for Safe Operability of Reworked Truck HO 68-B 8195 | Work complete. |
| Heating & Air Conditioning 141-M Building | Engineering work is complete. |
| Provide Operating & Safety Improvements 340 Building Tank Pit | Installation of improvements will be started in September. |
| Study of Cut-Off Facility for PRTR Fuel Elements | Summary requirements have been formulated. Estimate is being prepared. |
| Storm sash & shade screens for Buildings 300 Area Misc. Building Contract AT(45-1) 1290 (Sash & screen on 325, 327, 328, 3760. Screen only 3707-C and 3702 Building). | Contractor: Sun Screen Products Co. Spokane, Washington<br>Contract Amt. $10,734.74<br>Mod. #1 2,115.93<br>$12,850.67<br>Status: Completed. Contract was extended 12 days to 9-5-58, but work was finished and inspected 8-15-58.<br>Comments: Contract was modified to include storm windows on second floor of 3760 Building. |

Design and Drafting Services

| Title | Status & Description |
|---|---|
| Cesium Recovery | Based on present scope of work this job approximately 85% complete. |
| Non-Production Fuels Processing | Mechanical shear design 100% complete. Shear feed design is 40% complete. Dissolver design 20% complete. |
| ETR 6x9 Process Tube Project CA-681 | Work completed. |

| Title | Status & Description |
|---|---|
| Draw Bench Chain Support | Design work was performed to solve whip-lash, slack and vibration problems in a heavy drawbench chain about 40' between sprockets. |
| Ceramic Fuel Test Element | An assembly drawing and four detail views were made of this element. |
| Accelerator Positioner | Designed a positioner which will automatically move a 2-1/2 ton Van de Graaff Accelerator through four directions, (1) vertically, (2) horizontally, (3) pitch, and (4) yaw. |
| Fuel Element X-Ray Densitometer | Design a mechanism for transporting fuel elements through an X-ray beam, between an X-ray head and ion chamber at controlled rates of speed. Job 10% complete. |
| Fuel Rod Separator | Design initiated to provide a mechanism which will permit visual inspection of 19-rod cluster fuel elements. |
| Vacuum Annealing Furnace | Design was initiated for a special furnace. |
| Remotize Metallograph | Design is complete. |

Maintenance and Building Engineering Services

Arrangements were made to assume direct control of building machinery maintenance at month's end. This will assist in controlling 9% of the Building Maintenance and Operating budget as well as in planning long-term maintenance in the 300 Area.

Maintenance responsibility for 305-B and 314 Buildings were transferred to FPD's Manufacturing Maintenance to Plant Maintenance in anticipation of the 303 Area fence relocation. This relocation has been delayed for integration with drive-ways, but an approved drawing was ready for contract negotiation at month's end.

A meeting was held at which a tentative schedule and plan of transfer was established in connection with the 231-Z transfer from CPD to HLO. A physical inventory of equipment is being made and transfer papers are being prepared for the equipment to be transferred.

The exteriors of metal walls 329 and 3760 Buildings have been painted. The concrete was being painted at month end.

The Maintenance & Building Engineering Landlord costs for July were $71,256 or 6% of the budgeted funds. This compared favorably with the 6% expenditure for the same period in 1957.

Partitioning of the second floor offices 328 Building, for the Programming Operation, was about 30% complete at month end.

Two office moves were completed involving rooms 28, 32, and 33 in the 3702 Building, and rooms 111, 203, and 215 in the 3706 Building.

Plans are underway to reroof the 222-U Building and the 146-FR Building. Completion date estimate is 10/31/58.

Twenty-five new metal desks were allocated to HLO. These were delivered as follows: 3702 (18); 326 (4); 329 (1); 108-F (1); and 141-M (1).

Engineering work was started to improve existing conditions in the 147-F Process Pump House.

Alterations in the 622 Building are 85% complete.

306 Building Air Filter Modification - Partial shipment was made of material 8-18-58. Remainder of material scheduled for shipment 8-21-58. Installation is planned for September.

306 Building Water Softener - Installation was completed 8-14-58. Equipment is now in service.

306 Water Filter - Confirmed shipping date of 9-19-58 has been received from the vendor. Installation will be made after receipt of material.

3706 Building, room 108, Electronics Laboratory - Stud wall partition, painting and floor tile repairs have been completed.

325 Building Gas Storage Extension - Metal wall is expected on plant the week of 8-29-58. Completion of the job is planned for 9-5-58. The hydrogen manifolds are in service.

3760 Building Heating and Ventilation - A study of recommendations made relative to modifying this system has been made. A plan to incorporate these recommendations into a single job item is being prepared.

325 Building Vacuum Pumps - Study of the problem of 325 Building Kinney DVD 12814 rotary vacuum pumps oil waste to the atmosphere was continued. The particulate carry-over was found to be in the one micron range. It was estimated that a significant percentage of the total oil lost was in vapor form because of the ease with which cooling coalesced droplets. Design is complete for reducing the escape of oil vapor to atmosphere.

326 Building Heating and Ventilating - Study is being made of re-zoning mezzanine rooms 1, 2, and 3 in Building 326. Providing a new thermostat in M 1, 2, 3 to operate the existing booster coil and a new booster coil down stream from M 1, 2, 3 to be tied to present Zone 1 thermostat is a solution being considered.

325 Building Distilled Water - Provision of more adequate distillation capacity for Building 325 is under consideration. Means of raising feed pressure of demineralized water to still is needed.

Specifications are being prepared for a lump sum contract to repair roofs on 146-FR and 222-U Buildings.

Third Party Inspection of the Code Vessels in 327 Building (15 vessels) and 3726 Building propane storage tank was conducted. Orders have been issued to correct exceptions noted during this inspection which was held on August 18, 1958.

Survey and inspection of code vessels is essentially complete. A report is to be issued in September.

Survey of liquid helium requirements for HAPO and HLO is essentially complete. Report to be issued in September.

TECHNICAL INFORMATION OPERATION

A proposed Commission policy regarding an author's right to royalties and honoraria awarded for articles or books he wrote in connection with his job, has been received. The policy covers such matters as (1) writing during working hours, (2) use of Company graphics and reproduction facilities, and (3) retention of royalties or honoraria offered. The proposed policy was forwarded to Level 2 Managers for comment. Hanford's comments will be sent to the Commission after consolidation of the replies from the Level 2 components and review by the HAPO Counsel.

Arrangements have been made to obtain 50 copies of the Armed Services Technical Information Agency's periodic Technical Abstract Bulletin. This bulletin lists classified and unclassified reports originated by the various armed services groups and their contractors. Copies of the bulletin will be addressographed in Files for distribution to individuals who wish to receive it routinely. Copies of the documents listed in the Bulletin will be obtained for HAPO personnel by Technical Information, upon request.

Four British reactor films are expected at HAPO soon. The Communications Specialists were asked to inform the library of the anticipated number of showings needed by their components. Arrangements have been made to schedule the showings and to announce the schedules to the Departments.

Procedures for the control of classified documents were prepared and mailed to Air Products, Inc., a new subcontractor for HAPO. Covered in the procedures were the accounting for and maintaining records of documents created and received by the subcontractor, internal circulation, destruction, offsite transmittal, and periodic inventories. The Air Products, Inc. document records will be monitored by Classified Files, and an inventory record for each accountable copy will be established. At the conclusion of their contract, it should be a relatively simple matter to clear them of their classified document responsibilities.

New instructions on classification of Hanford maps and photographs were distributed to the field. The present Hanford Classification Guide has been revised to include the new topics. The new instructions have raised a number of questions which will require further clarification by the AEC. Further information will be distributed to HAPO personnel as it is received. B. Feldman,

the Hanford Classification Liaison Officer from the Division of Classification, Washington, plans to spend the month of October at Hanford working on the Proposed Hanford Classification Guide. He recently spent a few days here discussing classification problems related to the design and construction of the NPR.

HOO has been working with the IPD Process Design Operation on the classification of NPR procurement activities. It now appears that if two topics of the present Hanford Guide can be declassified, most of the NPR procurement program can be conducted on an unclassified basis. HOO has asked the Division of Classification to consider declassifying these topics.

The Classification-Declassification Specialist submitted comments to AEC concerning a preliminary review from the Division of Classification of Topic 102 (as it relates to the NPR) of the Proposed Hanford Classification Guide, and its reaction to the general philosophy of the Proposed Guide. The Division of Classification contends that the Hanford proposals require a basic change in AEC policy. Hanford maintains that changes in interpretation of the present AEC policy are proposed in the Guide, but that a basic policy change is not needed. The Division of Classification has not indicated that the justifications submitted by Hanford to support the classifications proposed in the Guide were considered.

Ten copies of the US papers prepared for the Second International Conference on the Peaceful Uses of Atomic Energy are being received. These papers will be announced in special supplements to the "Weekly List of Additions to Technical Information Files." Copies of the foreign papers will be purchased from the United Nations' Document Service upon request.

The program of "weeding" the duplicate periodical collection has been completed. Nineteen cartons of material were shipped to the U.S. Book Exchange, and the remaining surplus periodicals were discarded. Before this action, the duplicate periodical collection completely filled three stacks; after a 75% reduction it can be shelved on two stacks with ample room for growth. The release of one stack made possible the much-needed shifting of the book collection. The book collection has been arranged in such a way that additional shifting should not be necessary for several years. A systematic procedure was developed for the binding, destruction and retention of periodicals subscribed to by the library. This procedure will prevent the accumulation of too many surplus periodicals in the future.

Work Volume Statistics

| Document Distribution and Files | July | August |
|---|---|---|
| Documents routed and discharged (copies) | 16,358 | 15,561 |
| Documents issued (copies) | 10,720 | 10,064 |
| Documents sent offsite (copies) | 4,045 | 3,574 |
| Documents reserves filled (copies) | 533 | 784 |
| Documents picked up and delivered | 22,594 | 18,655 |

| Document Accountability | July | August |
|---|---|---|
| Holders of classified documents whose files were inventoried | 561 | 317 |
| Documents inventoried in Files (copies) | 16,890 | 8,937 |
| Documents destroyed or retired (copies) | 4,307 | 3,316 |
| Documents revised (copies) | 1,190 | 781 |
| Documents pulled and documents filed (copies) | 5,938 | 10,884 |
| Documents reclassified | 632 | 328 |
| Accountable copies of SECRET and DOCUMENTED CONFIDENTIAL documents on site | 201,463 | 204,290 |

| Reference and Publication | | |
|---|---|---|
| Books cataloged (new titles) | 72 | 68 |
| Books added to the collection (volumes) | 297 | 217 |
| Ready reference questions answered by professional staff | 163 | 64 |
| Literature searches by professional staff | 103 | 109 |
| Reports abstracted (titles) | 195 | 198 |
| Formal reports prepared (titles) | 7 | 14 |
| Offsite requests for HAPO reports (copies) | 100 | 278 |
| Reports released to CAP (titles) | 20 | 20 |

| Library Acquisitions and Circulation | | |
|---|---|---|
| Books ordered (volumes) | 462 | 361 |
| Periodicals ordered | 88 | 33 |
| Books circulated (volumes) | 1,915 | 1,380 |
| Periodicals circulated (issues) | 4,812 | 3,697 |
| Inter-library loans | 87 | 72 |
| Films borrowed or rented | 23 | 27 |
| Industrial film showings | 69 | 58 |
| Bound periodicals added to the collection | * | 95** |

Library collection:

| | Main Library | W-10 Library | 108-F Library | Ind. Med. | Totals |
|---|---|---|---|---|---|
| No. of books | 24,059 | 8,068 | 1,349 | 1,895 | 35,371 |
| No. of bound periodicals | 11,167 | 1 | 1,423 | 96 | 12,687 |
| | 35,226 | 8,069 | 2,772 | 1,991 | 48,058 |

* Figures for July not available separately.
** July and August figures combined.

| Classification and Declassification | July | August |
|---|---|---|
| Documents, including drawings and photographs, reviewed for downgrading or declassification | 130 | 80 |
| Documents submitted to Declassification Branch, Oak Ridge | 85 | 7 |
| Documents and papers (intended for oral presentation or publication) reviewed for appropriate classification | 11 | 26 |

LABORATORIES ADMINISTRATION

Timely revisions were issued on nine Organization and Policy Guides. Two instructions were combined into OPG No. 03.7.12, Accidents Involving Government Vehicles - Motor Vehicle Safety Responsibility Act, replacing OPG No. 10.1.2 and OPG No. 10.1.6. In addition two security instructions were reissued as one, OPG No. 09.2, Senitive Positions, Security Clearances and Identification, thus eliminating OPG No. 09.4. OPG No. 05.6.1, Official Travel, was reissued to include former OPG No. 10.1.4, Use of Private Automobiles on Official Travel.

Specific delegations of authority were issued as covered by OPG No. 02.3.1, Approval Authorizations.

The term of contract No. DDR-29, Nuclear Metals, Inc. was extended. Two new contracts were pending approval at the end of the month: No. DDR-35, Aluminum Company of America for aluminum tubes; and No. CA-199, M. J. Sinnott for consulting services on metallurgical problems. Contract No. DDR-38 with Battelle Memorial Institute for work on properties of Zircaloy 2 was closed out.

Assistance was given to Production Purchasing Operation in determining a laundry and dry cleaning service estimate to be used in negotiating a new contract.

The property management was closed out on the following FY-1958 Assistance to Hanford Authorizations:

No. ATH-HLO-1-58-A Consultation by Dr. Poritsky
No. ATH-HLO-1-58-C Bearing Analysis Study

The property-management close out on No. ATH-HLO-1-58-D, Fuel Element Failure Detection, and No. ATH-HLO-2-58, Solvent Extraction Study, is being held up pending receipt of final reports.

Manager
LABORATORY AUXILIARIES

JL Boyd:jcw

BUDGET CLASSIFICATION: General Plant Projects - FY 1957 - AEC-23-57-n-2

# MONTHLY PROJECT REPORT
HANFORD LABORATORIES OPERATION

HW - 57225
MONTH: August, 1958

| PROJECT NUMBER | TITLE | EST. TOTAL PROJECT COST | AUTHORIZATION INFORMATION: AMOUNT / DATE | PROJECT PROGRESS IN PER CENT: DESIGN SCHED. / DESIGN ACTUAL | PROJECT PROGRESS IN PER CENT: CONST. SCHED. / CONST. ACTUAL | STARTING DATE: DESIGN / CONST. | DIRECTIVE COMP. DATE: DESIGN / CONST. | ESTIMATED COMP. DATE: DESIGN / CONST. |
|---|---|---|---|---|---|---|---|---|
| CA-658 | Shielded Personnel Monitoring Station - 747 Building | $ 140,000 | $ 150,000 / 2-4-57 | 100 / 100 | 65 / 62 | 2-18-57 / 3-11-58 | - - - / 12-31-58 | 12-19-57* / 12-15-58 |

USING COMPONENT: Radiation Protection Operation
FEO ENGINEER: D. S. Jackson

REMARKS:

All activity on the project was centered on the fabrication of the shielded cell. The cell was mocked-up in the fabrication shop. It is expected to be ready for shipment to Richland about September 15, 1958.

* Actual date.

General Plant Projects - FY 1958 - AEC-2-23-58-L

| PROJECT NUMBER | TITLE | EST. TOTAL PROJECT COST | AUTHORIZATION INFORMATION: AMOUNT / DATE | PROJECT PROGRESS IN PER CENT: DESIGN SCHED. / DESIGN ACTUAL | PROJECT PROGRESS IN PER CENT: CONST. SCHED. / CONST. ACTUAL | STARTING DATE: DESIGN / CONST. | DIRECTIVE COMP. DATE: DESIGN / CONST. | ESTIMATED COMP. DATE: DESIGN / CONST. |
|---|---|---|---|---|---|---|---|---|
| CA-765 | Additions to the 314 Building | $ 35,000 | $ 46,000 / 11-15-57 | 100 / 100 | 69 / 65 | 10-14-57 / 3-27-58* | - - - / 11-15-58 | 3-7-58** / 11-15-58 |

USING COMPONENT: Reactor & Fuels R & D
FEO ENGINEER: A. W. Hervin

REMARKS:

The contractor has installed the steel roof joists, corrugated metal and vermiculite sub-roof. Work is progressing on the inside electrical work, blocking in windows on east side of existing offices, and partitions.

* CPFF Construction Contractor started work on 3-27-58 and FP Contractor started work on 5-14-58. ** Actual date.

| PROJECT NUMBER | TITLE | EST. TOTAL PROJECT COST | AUTHORIZATION INFORMATION: AMOUNT / DATE | PROJECT PROGRESS IN PER CENT: DESIGN SCHED. / DESIGN ACTUAL | PROJECT PROGRESS IN PER CENT: CONST. SCHED. / CONST. ACTUAL | STARTING DATE: DESIGN / CONST. | DIRECTIVE COMP. DATE: DESIGN / CONST. | ESTIMATED COMP. DATE: DESIGN / CONST. |
|---|---|---|---|---|---|---|---|---|
| CA-778 | Expansion of the 305-B Building | $ 55,000 | $ 55,000 / 12-11-57 | N.S. / 100 | 48** / 29** | 4-4-58 / 6-7-58 | 5-15-58 / 10-15-58 | 5-7-58* / 10-1-58# |

USING COMPONENT: Physics & Instruments R & D
FEO ENGINEER: R. C. Ingersoll

REMARKS:

The floor slab was poured August 20 & 21, 1958. The reinforcing beam in the 305-B Building has been placed and grouted in. The contractor's work has been delayed due to strike-bound material.

** Includes work performed by GE Plant Forces relocating conduit in the 305-B Building and outside electrical work performed by CPFF Construction Contractor.

* Actual date. # A-E scheduled date.

BUDGET CLASSIFICATION: General Plant Projects - FY 1958 - AEC-2-23-58-L

# MONTHLY PROJECT REPORT
HANFORD LABORATORIES OPERATION

MONTH: August, 1958

| PROJECT NUMBER | TITLE | EST. TOTAL PROJECT COST | AUTHORIZATION INFORMATION: AMOUNT / DATE | PROJECT PROGRESS IN PER CENT: DESIGN SCHED. / DESIGN ACTUAL | PROJECT PROGRESS IN PER CENT: CONST. SCHED. / CONST. ACTUAL | STARTING DATE: DESIGN / CONST. | DIRECTIVE COMP. DATE: DESIGN / CONST. | ESTIMATED COMP. DATE: DESIGN / CONST. |
|---|---|---|---|---|---|---|---|---|
| CG-779 | Additions to Separations Development Facilities - 321 Building | $ 27,900 | $ 27,900<br>5-22-58 | 100<br>80 | 80<br>85 | 5-26-58<br>6-19-58 | - - -<br>1-31-59 | 6-15-58<br>12-1-58 |

USING COMPONENT: Chemical Research & Development

FED ENGINEER: J. T. Lloyd

REMARKS:

The platform over the "A" Cell has been completed. The outside addition is complete except for handrail, procurement of rectifier, hydrogen fluoride room exhauster and HF manifold. The air duct extension to "A" Cell basement is being fabricated. The new lights have been installed under the "A" Cell platform.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CAH-794 | Geological and Hydrological Wells - FY 1958 | $ 49,000 | $ 49,000<br>4-16-58 | 100<br>100 | 36<br>12 | 4-7-58<br>7-8-58 | - - -<br>12-31-58 | 5-15-58*<br>12-31-58 |

USING COMPONENT: Chemical Research & Development

FED ENGINEER: H. E. Ralph

REMARKS:

The contractor is currently drilling on wells 699-24-46 (#1) and 699-2-33 (#3), which have reached a depth of 300 feet and 180 feet respectively. The lack of equipment necessary to haul supplies and equipment through the sandy terrain and shortage of personnel to operate the equipment, appears to be the cause of the contractor being 24% behind schedule.

* Actual date.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CGH-796 | Facilities for Isotope Study on Animals | $ 49,800 | $ 49,800<br>5-22-58 | N.S.<br>100 | N.S.<br>70 | 5-22-58<br>6-12-58 | 7-27-58<br>11-1-58 | 7-25-58*<br>11-1-58 |

USING COMPONENT: Biology

FED ENGINEER: J. T. Lloyd

REMARKS:

All concrete floors have been poured with pipe gutters in place. Stalls in barn No. 2 have been completely installed. Electric wall type heaters have been installed in barns Numbers 1, 2 and Annex. Stanchions, feeding troughs and partitions for barn No. 1 have been almost completely fabricated. Installation of these is underway.

* Actual date.

AM-7300-819 ( 5-58)

BUDGET CLASSIFICATION: General Plant Projects - FY 1958 - AEC-2-23-58-L

# MONTHLY PROJECT REPORT
HANFORD LABORATORIES OPERATION

HW - 57225
MONTH: August, 1958

| PROJECT NUMBER | TITLE | EST. TOTAL PROJECT COST | AUTHORIZATION INFORMATION: AMOUNT / DATE | PROJECT PROGRESS IN PER CENT: DESIGN SCHED. / DESIGN ACTUAL | PROJECT PROGRESS IN PER CENT: CONST. SCHED. / CONST. ACTUAL | STARTING DATE: DESIGN / CONST. | DIRECTIVE COMP. DATE: DESIGN / CONST. | ESTIMATED COMP. DATE: DESIGN / CONST. |
|---|---|---|---|---|---|---|---|---|
| CGH-803 | Alterations - Building 231-Z | $ 49,600 | $ 49,600 / 6-2-58 | 0 / 0 | 65 / 65 | N.S. / 7-7-58 | - - - / 11-15-58 | - - - / 11-15-58 |
| | | USING COMPONENT: Reactor & Fuels R & D | | | | FEO ENGINEER: J. T. Lloyd | | |

REMARKS:

Cell No. 4 has been completed and is in use. The large hood in Cell No. 2 has been removed; the small hood has been cut loose and is ready for moving. The large hood in Cell No. 3 has been cut loose except for the exhaust duct. It may be necessary to cut this hood into two pieces for removal, due to interferences. This hood is very highly contaminated.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CGH-804 | Ceramic Fuels Press Enclosure - 325 Building | $ 41,000 | $ 41,000 / 6-2-58 | 100 / 100 | N.S. / 0 | 6-19-58* / 10-2-58# | - - - / 1-15-59 | 8-1-58* / 1-2-59# |
| | | USING COMPONENT: Reactor & Fuels R & D | | | | FEO ENGINEER: R. C. Ingersoll | | |

REMARKS:

Bid package, combining press enclosure construction (CGH-804) and press installation (CG-758), was issued on August 29, 1958. The bid opening is scheduled for September 17, 1958.

*Actual dates. # Project Proposal dates.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CGH-809 | Electrical Modifications - 328 Building | $ 40,000 | $ 40,000 / 6-30-58 | N.S. / 40 | 0 / 0 | 7-30-58 / 10-30-58 | - - - / 3-1-59 | 9-30-58 / 3-1-59 |
| | | USING COMPONENT: Laboratory Auxiliaries | | | | FEO ENGINEER: R. C. Ingersoll | | |

REMARKS:

Comment drawings and purchase specifications for main switch gear were issued August 28, 1958.

BUDGET CLASSIFICATION
General Plant Projects - FY 1958 - AEC-2-23-58-L

**MONTHLY PROJECT REPORT**
HANFORD LABORATORIES OPERATION

HW - 5722
MONTH August, 1958

| PROJECT NUMBER | TITLE | EST. TOTAL PROJECT COST | AUTHORIZATION INFORMATION AMOUNT / DATE | PROJECT PROGRESS IN PER CENT DESIGN SCHED. / ACTUAL | PROJECT PROGRESS IN PER CENT CONST. SCHED. / ACTUAL | STARTING DATE DESIGN / CONST. | DIRECTIVE COMP. DATE DESIGN / CONST. | ESTIMATED COMP. DATE DESIGN / CONST. |
|---|---|---|---|---|---|---|---|---|
| IR-240 | Removal of Obsolete Melt Plant Equipment - 314 Building | $ 19,000 | $ 19,000<br>6-24-58 | None<br>None | N.S.<br>60 | None<br>6-27-58 | - - -<br>11-11-58 | - - -<br>11-11-58 |

USING COMPONENT: Reactor & Fuels R & D
FED ENGINEER: A. W. Hervin

REMARKS:

The first furnace has been removed. The concrete pedestals that supported the furnace have been knocked down to floor level. Work is progressing on removal of piping and ductwork.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Modification of the 15-Ton Canyon Crane - 327 Building | None to date<br>$ 49,500 None | 0<br>0 | 0<br>0 | 1*<br>5* | None<br>None | 3*<br>7* |

USING COMPONENT: Reactor & Fuels R & D
FED ENGINEER: R. C. Ingersoll

REMARKS:

The project proposal is being held up pending the sponsor's decision to proceed.

* Months after authorization.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

USING COMPONENT
FED ENGINEER

REMARKS:

BUDGET CLASSIFICATION: Equipment Not Included in Construction Projects - Program Class 2900

# MONTHLY PROJECT REPORT
HANFORD LABORATORIES OPERATION

HW - 57229

MONTH: August, 1958

| PROJECT NUMBER | TITLE | EST. TOTAL PROJECT COST | AUTHORIZATION INFORMATION AMOUNT / DATE | PROJECT PROGRESS IN PER CENT DESIGN SCHED. / DESIGN ACTUAL | PROJECT PROGRESS IN PER CENT CONST. SCHED. / CONST. ACTUAL | STARTING DATE DESIGN / CONST. | DIRECTIVE COMP. DATE DESIGN / CONST. | ESTIMATED COMP. DATE DESIGN / CONST. |
|---|---|---|---|---|---|---|---|---|
| CG-661 | Additional Heat Generating Facility - 189-D Building | $ 475,000* | $ 664,000<br>9-18-57 | 100<br>95 | 0<br>0 | 12-6-56<br>11-1-58 | 10-1-58**<br>8-31-59 | 10-1-58<br>8-31-59 |
| | | USING COMPONENT: Reactor & Fuels R & D | | | | FED ENGINEER: A. W. Hervin | | |

REMARKS:

Vendor information has not been received from the General Electric Company; however, it is supposedly enroute. When this information is received, design can be completed. The transformers and saturable reactor have been shipped. The rectifiers and remaining components are scheduled for shipment near the end of September. Work is being started on the assembly of information for the Special Conditions of the contract. The middle of October appears to be the earliest that invitations to bid can be issued.

*Reduced primarily due to the less than anticipated cost of equipment.
**Scheduled date.

| PROJECT NUMBER | TITLE | EST. TOTAL PROJECT COST | AUTHORIZATION INFORMATION AMOUNT / DATE | PROJECT PROGRESS IN PER CENT DESIGN SCHED. / DESIGN ACTUAL | PROJECT PROGRESS IN PER CENT CONST. SCHED. / CONST. ACTUAL | STARTING DATE DESIGN / CONST. | DIRECTIVE COMP. DATE DESIGN / CONST. | ESTIMATED COMP. DATE DESIGN / CONST. |
|---|---|---|---|---|---|---|---|---|
| CA-681 | Hanford Equipment in the ETR | $1,200,000 | $1,200,000<br>8-12-57 | 100<br>100 | N.S.<br>86 | 9-17-56<br>4-7-58 | - - -<br>12-15-58 | 9-2-58<br>5-1-59* |
| | | USING COMPONENT: Reactor & Fuels R & D | | | | FED ENGINEER: H. Radow | | |

REMARKS: There are indications that AEC-IOO will give written permission to insert the 3 x 3 Loop in its reflector position without waiting for the AEC Hazard Survey Group approval. If this proves true, this insertion will be done at the next scheduled reactor shutdown starting the week of September 2, 1958. Design of the 6 x 9 Loop has been completed and procurement action on an expedited basis is underway. *Attainment of beneficial use of the 6 x 9 facility by January, 1959 is still the objective. However, a reappraisal of current factors, as well as delays resulting from possible further hold-up of the 3 x 3 insertion, indicates this will be very difficult to meet.

| PROJECT NUMBER | TITLE | EST. TOTAL PROJECT COST | AUTHORIZATION INFORMATION AMOUNT / DATE | PROJECT PROGRESS IN PER CENT DESIGN SCHED. / DESIGN ACTUAL | PROJECT PROGRESS IN PER CENT CONST. SCHED. / CONST. ACTUAL | STARTING DATE DESIGN / CONST. | DIRECTIVE COMP. DATE DESIGN / CONST. | ESTIMATED COMP. DATE DESIGN / CONST. |
|---|---|---|---|---|---|---|---|---|
| CG-682 | High Level Cut-Off and Examination Cell - 327 Building | $ 400,000 | $ 430,000<br>8-20-57 | 100<br>100 | 98<br>95 | 7-18-56<br>3-27-58 | - - -<br>10-1-58 | 6-26-57*<br>10-1-58 |
| | | USING COMPONENT: Reactor & Fuels R & D | | | | FED ENGINEER: A. W. Hervin | | |

REMARKS: Construction Operation has essentially completed the meehanite cell erection, the major exception being the painting. Some binding difficulty is being experienced with the cut-off saw; however, this is being corrected. The vendor for the patch panel has been on the job site, redoing electrical work which does not meet code requirements. Work is being performed by Plant Forces on the manipulators in an effort to make them work easier. The vendor on the can sealer was having a little difficulty; however, this has been resolved. The can sealer should be shipped the first part of September. The vendor making the service plugs for the cell is having casting and drilling difficulties. However, these plugs are not needed immediately, they could be installed at a later date during cold run-in operations.

* Actual date

UNCLASSIFIED

BUDGET CLASSIFICATION Equipment Not Included in Construction Projects - Program Class 2900

# MONTHLY PROJECT REPORT
HANFORD LABORATORIES OPERATION

HW - 57225
MONTH August, 1958

| PROJECT NUMBER | TITLE | EST. TOTAL PROJECT COST | AUTHORIZATION INFORMATION AMOUNT | AUTHORIZATION INFORMATION DATE | PROJECT PROGRESS IN PER CENT DESIGN SCHED. | PROJECT PROGRESS IN PER CENT CONST. SCHED. | STARTING DATE DESIGN | STARTING DATE CONST. | DIRECTIVE COMP. DATE DESIGN | DIRECTIVE COMP. DATE CONST. | ESTIMATED COMP. DATE DESIGN | ESTIMATED COMP. DATE CONST. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CA-695 | Radio Telemetering Network | $ 105,000 | $ 89,000 | 1-10-57 | 100 | 100 | N.S. | 25 | 2-22-57 | 7-25-57 | 4-15-57* | 5-15-58 | 5-27-57** | 1-1-59 |

USING COMPONENT: Physics & Instruments R & D
FED ENGINEER: J. T. Lloyd

REMARKS:

The AEC-HOO is preparing a project proposal revision. Instrument Laboratories, Inc., is waiting for approval to start fabrication on 20 production models. Motorola expects to ship the repeater station on September 9, 1958.

* Scheduled date, ** Actual date.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CG-785 | In-Reactor Studies Equipment - 105-KW Building | $ 230,000 | $ 15,000* | 100 # | 0 | 3-10-58 | None | 9-15-58 |
| | | | 2-12-58 | 99 # | 0 | None | None | None |

USING COMPONENT: Reactor & Fuels R & D
FED ENGINEER: H. Radow

REMARKS:

At the recent meeting to determine action to be taken, because of the rejection of capsule development from project funds, it was decided that the required work be segrated and only the creep rate test be undertaken. Accordingly, Fuels Development Operation is analyzing the new cost pattern and scheduling. They will negotiate with IPD regarding the availability of the R & D Funds required. The project proposal is being rewritten to include only the permanently installed portion of the facility.

#Preliminary design only.

*For preliminary design and services for project proposal requesting detail design and construction funds.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| CGH-801 | X-Ray Diffraction Cell - 327 Building | $ 120,000 | $ 10,000 | 12 | 0 | 6-10-58 | - - - | 12-24-58 |
| | | | 6-7-58 | 12 | 0 | None | None | 7-30-59 |

USING COMPONENT: Reactor & Fuels R & D
FED ENGINEER: R. W. Dascenzo

REMARKS:

Drafting work on the design has been started. Design is progressing slowly. The engineering is about 90% complete.



UNCLASSIFIED

UNCLASSIFIED

1238505

**MONTHLY PROJECT REPORT**
HANFORD LABORATORIES OPERATION

HW – 57225
MONTH August, 1958

BUDGET CLASSIFICATION: Equipment Not Included in Construction Projects - Program Class 2900

| PROJECT NUMBER | TITLE | EST. TOTAL PROJECT COST | AUTHORIZATION INFORMATION AMOUNT / DATE | PROJECT PROGRESS IN PER CENT DESIGN SCHED. / DESIGN ACTUAL | PROJECT PROGRESS IN PER CENT CONST. SCHED. / CONST. ACTUAL | STARTING DATE DESIGN / CONST. | DIRECTIVE COMP. DATE DESIGN / CONST. | ESTIMATED COMP. DATE DESIGN / CONST. |
|---|---|---|---|---|---|---|---|---|
| CGH-805 | High Temperature Tensile Testing Cell | $ 140,000 | $ 10,000<br>8-4-58 | 0<br>0 | 0<br>0 | 8-26-58<br>None | 4-1-59<br>10-1-59 | 4-1-59<br>10-1-59 |

USING COMPONENT: Reactor & Fuels R & D
FED ENGINEER: R. W. Dascenzo

REMARKS:
Directive HW-468, dated August 4, 1958, authorizing partial design funds in the amount of $10,000, has been received.

Equipment Not Included in Construction Projects - Program Class 4900

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CG-758 | Ceramic Fuels Development Press and Furnace Additions | $ 172,000 | $ 172,000<br>7-16-58 | 100<br>100 | N.S.*<br>40 | 8-22-57<br>1-20-58 | 2-1-58<br>10-1-58 | 2-28-58<br>10-1-58 |

USING COMPONENT: Reactor & Fuels R & D
FED ENGINEER: R. C. Ingersoll

REMARKS:
Furnace installation is 100% complete. Vendor's representative was present for the start-up on August 12, 1958. Operation was satisfactory and the furnace was accepted by K. A. Clark. Installation of press (CG-758) and press enclosure (CGH-804) are combined in one bid package which was issued August 29, 1958. Bid opening is scheduled for September 17, 1958.

* An overall construction schedule has not been established because the second phase construction (press installation) has not been scheduled.

New Construction - FY 1958

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CG-731 | Critical Mass Laboratory | $1,800,000 | $ 175,000<br>5-12-58 | 13<br>9 | 0<br>0 | 5-22-58<br>2-15-59 | - - -<br>None | 2-1-59<br>10-31-59 |

USING COMPONENT: Physics & Instruments R & D
FED ENGINEER: D. S. Jackson

REMARKS:
Design progress is behind schedule, primarily due to vacations during July and August. Comment drawings were issued on a revised layout, control room arrangement, reactor hood and mixing hood assemblies, and ventilation flow.

BUDGET CLASSIFICATION: New Construction - FY 1958

# MONTHLY PROJECT REPORT
HANFORD LABORATORIES OPERATION

HW - 57225

MONTH: August, 1958

| PROJECT NUMBER | TITLE | EST. TOTAL PROJECT COST | AUTHORIZATION INFORMATION: AMOUNT / DATE | PROJECT PROGRESS IN PER CENT: DESIGN SCHED. / DESIGN ACTUAL | PROJECT PROGRESS IN PER CENT: CONST. SCHED. / CONST. ACTUAL | STARTING DATE: DESIGN / CONST. | DIRECTIVE COMP. DATE: DESIGN / CONST. | ESTIMATED COMP. DATE: DESIGN / CONST. |
|---|---|---|---|---|---|---|---|---|
| CA-744 | Metallurgical Development Facility | $2,600,000 | $ 60,000 / 4-28-58 | 14 / 14 | 0 / 0 | 6-30-58 / N.S. | - - - / None | 9-1-59 / 9-1-60 |

USING COMPONENT: Reactor & Fuels R & D

PED ENGINEER: J. T. Lloyd

REMARKS:

The project proposal requesting total project funds was approved by the local AEC Review Board, with recommendations for approval by AEC-Washington. Design is proceeding on schedule.

| PROJECT NUMBER | TITLE | EST. TOTAL PROJECT COST | AUTHORIZATION INFORMATION: AMOUNT / DATE | PROJECT PROGRESS IN PER CENT: DESIGN SCHED. / DESIGN ACTUAL | PROJECT PROGRESS IN PER CENT: CONST. SCHED. / CONST. ACTUAL | STARTING DATE: DESIGN / CONST. | DIRECTIVE COMP. DATE: DESIGN / CONST. | ESTIMATED COMP. DATE: DESIGN / CONST. |
|---|---|---|---|---|---|---|---|---|
| CA-749 | High Level Radiochemistry Facility | $ 950,000 | $1,070,000 / 4-21-58 | 75 / 73 | 1 / 1 | 6-15-58 / 8-14-58 | - - - / 7-10-59 | 11-15-58 / 6-30-59 |

USING COMPONENT: Chemical Research & Development

PED ENGINEER: R. W. Dascenzo

REMARKS:

Design is slightly behind schedule due to incorporation of 14 design changes. The drawings are 40% complete and 21% of the specifications have been completed. Mr. Edward Arndt and Mr. Frank Hume of Bohna & Company, Inc., visited the Commission on August 18 & 19. The financial compensation on 11 of the 14 General Electric Company requested design changes was settled. Excavation has been completed.

| PROJECT NUMBER | TITLE | EST. TOTAL PROJECT COST | AUTHORIZATION INFORMATION: AMOUNT / DATE | PROJECT PROGRESS IN PER CENT: DESIGN SCHED. / DESIGN ACTUAL | PROJECT PROGRESS IN PER CENT: CONST. SCHED. / CONST. ACTUAL | STARTING DATE: DESIGN / CONST. | DIRECTIVE COMP. DATE: DESIGN / CONST. | ESTIMATED COMP. DATE: DESIGN / CONST. |
|---|---|---|---|---|---|---|---|---|
| CGH-790 | High Level Radioactive Receiving and Storage Addition - 327 Building | $ 325,000 | $ 325,000 / 6-25-58 | 34 / 35 | 0 / 0 | 6-23-58 / 2-1-59 | - - - / 2-1-60 | 12-1-58 / 2-1-60 |

USING COMPONENT: Reactor & Fuels R & D

PED ENGINEER: A. W. Hervin

REMARKS:

Design work is progressing on the structural steel and concrete, wet storage basin and canal, ventilation and heating, and the decontamination chamber. Bid opening for the 20-ton crane is scheduled for September 8, 1958.

AM-7500-518 ( 5-58)

VISITS TO HANFORD WORKS

| Name | Dates of Visits | Company or Organization Represented & Address | Reason for Visit | H.W. Personnel Contacted | Access to Restricted Data | Areas & Buildings Visited |
|---|---|---|---|---|---|---|
| E. B. Montgomery | 8-11-58 | GE's Computer Division Phoenix, Arizona | Discuss machines for storage and retrieval of tech. info. | C.G. Stevenson<br>A.F. McConiga<br>S.P. Gydesen | No | 300 - 3760 |
| E. D. Arndt & F. Hume | 8-18 & 8-19-58 | B.D. Bohna & Co.,Inc. San Francisco, Calif. | Review Design changes on CA-749 | R.W. Dascenzo | No | 300 - PRTR Site |
| Mr. Battersby | 8-7-58 | Kirk Engineering Co. Seattle, Wash. | Meet with Kirk employees working at HAPO | J.W. Sadler | No | 300 - 3706 |

VISITS TO OTHER INSTALLATIONS

| Name | Dates of Visit | Company Visited and Address | Reason for Visit | Personnel Contacted | Access to Restricted Data |
|---|---|---|---|---|---|
| D. S. Jackson | 8-18-58 | Todd Shipyards Corp. Seattle, Wash. | Inspect monitoring cell being fabricated in vendor's shop and discuss corrective action needed to insure an acceptable finished product. | Mr. MacLean<br>Mr. Nesser<br>Mr. Bennet | No |

# EMPLOYEE RELATIONS OPERATION MONTHLY REPORT

## GENERAL

At month's end, the staff of the Hanford Laboratories Operation totalled 1232, including 584 exempt and 648 nonexempt employees. Of the total exempt employees, there were 518 with college degrees, including 498 technical degrees as follows: BS - 284, MS - 109, Ph.D. - 105. There were 33 nonexempt employees with degrees.

## PERSONNEL DEVELOPMENT

The 1958 Summer Institute of Nuclear Energy was concluded on August 15th. The AEC Radiological Physics Fellowship Program terminated August 22nd. Initial feedback for both programs is favorable.

Communications channels have been established with the area educational institutions to provide catalogs and schedules for HLO personnel.

Ten employees completed "Understanding People". A survey of interest level for continuing PBM-I has been started. Survey returns will be used to guide the frequency of future PBM-I sessions in HLO.

Twenty-five requisitions were received during the month; twelve were filled; leaving twenty-three open. The open requisitions include eight Engineering Assistants, one Laboratory Assistant, one Bioanalyst, one Biological Assistant, one Machinist Journeyman, four General Clerks C, two General Clerks B, and three Secretaries. There are two requisitions on a "hold" status. Transfers are pending for twelve of the open requisitions.

Three Personnel Meters Clerks are scheduled to transfer the second week in September, reducing the number of Personnel Meters Clerks tentatively scheduled to be laid off in September.

Seven transfer requests were received during the month of August. The reasons given were as follows: two - more experience, one - added experience, two - day job, one - more in line with interest, one - advancement.

## COMMUNICATIONS

A proposal has been developed for revision of HLO mass media and distribution techniques. It is expected that major improvements in the time required for distribution of information to employees will be realized.

The technical competence portion of the Operation Upturn was introduced to HAPO communications specialists by the HLO specialist. The technical competence program is currently directed at HAPO contributions to the Geneva Conference. HLO Operation Upturn activities included the announcement to employees of the availability of monogrammed cigarette lighters.

As a result of a previous visit by their representatives, the National Geographic Magazine includes two photographs of HLO activities in its September issue. A Time magazine photographer also took photographs of HLO facilities for consideration for a future issue of Time.

Approximately 3000 people visited the radiation protection display exhibited at the Benton-Franklin County Fair by Radiation Protection Operation. Preliminary arrangements were begun to send the display to a small business conference in Seattle.

Twenty-three signed articles, technical papers and speeches were processed for clearance in August.

One Manager's luncheon was held in August for 26 exempt people.

## HEALTH, SAFETY AND SECURITY

Laboratories personnel worked a total of 185,000 man-hours during the month with no disabling injuries. Since September 1, 1956, a total of 4,525,000 man-hours have been completed with no disabling injuries. The medical treatment frequency for August was 1.83 as compared with 1.18 during July.

There were 2 security violations during the month, bringing the total for the calendar year to 34.

## UNION RELATIONS

A meeting is scheduled for September 5, 1958 with Company and Union representatives in an attempt to resolve the Wonacott case without proceeding to arbitration.

Negotiations were resumed with the Regional Monitors at a meeting on August 12, 1958. Both the Company and the Union will be presenting counter proposals at a meeting to be held in the near future.

The arbitration hearing of the Maki case is scheduled to be held in Portland on October 6, 1958.

Four grievances were received during August, two of which were answered satisfactorily at Step I and two are pending Step II discussions. Three of the grievances pertained to assignment of work and the fourth pertained to action following misappropriation of a compass.

## PROFESSIONAL PERSONNEL PLACEMENT

During August seven Ph.D. candidates visited Hanford for employment interviews. HLO extended two offers, and one HLO offer was accepted. There was no other Hanford Ph.D. offer action. To date, 15 Ph.D. candidates have accepted HLO offers. Two IPD offers have been accepted, for a Hanford total of 17. In addition, six offers were extended to experienced BS/MS candidates. Four of these were accepted and five were placed on the roll. There was no offer action to Program BS/MS candidates during the month; however, three offers remain open.

Firm recruiting dates have been established for the six schools coordinated by HAPO for Ph.D. recruiting. Plans for BS/MS recruiting have been made for recruiting at 25 schools in the north central, south, and western recruiting regions.

A detailed study of technical losses for the past five years is underway.

Philip A. Ard, a Technical Graduate, suffered a disabling injury on August 13 while on assignment in IPD - Equipment Development. Mr. Ard inadvertently contacted a 13.7 kilovolt highline with a piece of aluminum tubing that he was holding. He was confined to Kadlec Hospital for treatment of burns and observation.

An accident investigation committee reviewed the incident on August 14. A detailed report of the accident, "Hanford Atomic Products Operation Safety Investigation, IPD Disabling Injury No. 58-5" was submitted on August 15.

A series of four conferences were conducted this month for members of the Technical Graduate Program. Each Program member attended one of the conferences. Dr. K. B. Bengtson participated in the conference by describing the operation of the University of Washington School for Graduate Study.

A conference for Technician Trainees was held this month to award certificates in recognition of completion of the Technician Training Program. Certificates were also awarded to eleven 1957 graduates who are presently working as Engineering Assistants at HAPO.

Nine new Technician Trainees reported for work and are presently engaged in their first six-month training assignment. Six additional new Program members are expected to report by September 8, bringing the total class to fifteen. These men will not be available for permanent placement as Engineering Assistants at HAPO until July, 1960.

## EMPLOYEE COMPENSATION

Updated median salary curves for 1958 have been compiled for all HLO college graduates.

Salary statistics for HLO individual contributor engineering and scientific personnel were compiled and forwarded to Relations and Utilities for inclusion in a salary survey being conducted by the Goodyear Atomic Corporation.

Six positions in Chemical Research & Development were audited during the month.

The Nonexempt Compensation Study is proceeding on schedule. To date, five progress reports have been issued by the specific study groups.

Seven suggestions were approved for awards totalling $115 at the August meeting of the HLO Suggestion Board. The average year to date suggestion award for HLO is $25.53, with a ratio of awards to savings being 11.3%. Effective August 29, a new six-page "package" suggestion form was instituted at HAPO to replace the familiar single sheet form. All suggestion boxes within Hanford Laboratories have been supplied with the new forms.

Two HLO employees retired during the month. Louise S. Nunn, Radiation Protection Operation, was the first HLO woman employee to terminate with vested pension rights. Arthur W. Lade, Biology Operation, retired under the normal provisions of the Pension Plan.

Hanford Laboratories' participation in Employee Benefit Plans is as follows:

| Year 1958 | Insurance | Pension Plan | Savings Stock Bonus | Savings Plan |
|---|---|---|---|---|
| Jan. | 99.6 | 98.4 | 60.6 | 7.5 |
| Feb. | 99.7 | 98.5 | 61.3 | 8.2 |
| Mar. | 99.7 | 98.6 | 61.9 | 8.7 |
| Apr. | 99.7 | 98.6 | 61.3 | 7.9 |
| May | 99.7 | 98.6 | 61.3 | 7.6 |

| Year 1958 | Insurance | Pension Plan | Savings Stock Bonus | Savings Plan |
|---|---|---|---|---|
| June | 99.7 | 98.9 | 61.4 | 7.6 |
| July | 99.8 | 98.7 | 60.6 | 7.0 |
| Aug. | 99.8 | 98.7 | 61.9 | 7.0 |

Manager
Employee Relations

T.G. Marshall:tr

VISITORS TO HAPO

| Name | Date of Visit | Company Represented | Reason for Visit | Personnel Contacted | Access to Restricted Data | Areas & Bldg. Visited |
|---|---|---|---|---|---|---|
| W.R. Jacobson | 8/5-7 | General Electric Co. Employee Compensation Services, N.Y. | Nonexempt compensation study. | H.A. Paulsen<br>T.G. Marshall | None | 700-703 |
| J.T. Klapper | 8/25 | General Electric Co. Public & Emp. Rel. Services, N.Y. | Discuss possible research project of mutual interest to the Services and Hanford. | H.A. Paulsen | None | 700-703 |
| G.Roy Fugal | 8/21 | Public & Emp. Rel. Services, N.Y. | Discussed personnel practices and evaluation of relations with white collar employees. | H.A. Paulsen<br>R.S. Himmelright | None | 700-703 |

## TABLE II. PROFESSIONAL PERSONNEL PLACEMENT

A - Technical Recruiting Activity - HAPO - Sept. 1, 1957 to Date

| | Visits to Richland | | | | Offers* | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Cases Considered | Invited | Visited | To Visit | Extended | Accepted | Open | % Accept. | On the Roll |
| Ph.D. | 813 | 233 | 101 | 13 | 66 | 17 | 3 | 27% | 18 |
| Exp. BS/MS | 426 | 27 | 17 | 2 | 30 | 19 | 3 | 70% | 15 |
| Program BS/MS | 502 | 0 | 0 | 0 | 50 | 19 | 3 | 40% | 19 |
| Summer Program | | | | | | | | | |
| Juniors | 70 | 0 | 0 | 0 | 10 | 9 | 0 | 90% | 9 |
| Graduates | 109 | 0 | 0 | 0 | 10 | 9 | 0 | 90% | 9 |
| Professors | 40 | 1 | 1 | - | 9 | 8 | 0 | 89% | 8 |

*Offer totals include offers open on Sept. 1, 1957

| | |
|---|---|
| Ph.D. | 16 |
| Exp. BS/MS | 0 |
| Program BS/MS | 1 |

B - Technical Recruiting Activity -HLO - Sept. 1, 1957 to Date

| | Visits to Richland | | | | Offers* | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Cases Considered | Invited | Visited | To Visit | Extended | Accepted | Open | % Accept. | On the Roll |
| Ph.D. | 813 | 233 | 101 | 13 | 59 | 15 | 2 | 27% | 16 |
| Exp. BS/MS | 143 | 22 | 18 | 2 | 20 | 10 | 2 | 50% | 8 |
| Program BS/MS | (Off Program Placement) | | | | 19 | 19 | 0 | 100% | 19 |
| Summer Program | | | | | | | | | |
| Juniors | 70 | 0 | 0 | 0 | 2 | 2 | - | 100% | 2 |
| Graduates | 109 | 0 | 0 | 0 | 5 | 5 | 0 | 100% | 5 |
| Professors | 40 | 1 | 1 | 0 | 2 | 1 | 0 | 50% | 1 |

*Offer totals include 14 Ph.D. offers open on Sept. 1, 1957

C - Technical Graduate and Technician Training Program
Month Ending August 31, 1958

| | TG Program | TT Program |
|---|---|---|
| Number personnel on assignment (HAPO TG Program 43) (West. District E.P. 5) | 48 | 18 |
| Distribution of assignments by Depts. | | |
| HLO | 13 | 13 |
| CEO | 1 | 0 |
| R&UO | 0 | 0 |
| FPD | 4 | 0 |
| IPD | 27 | 5 |
| CPD | 3 | 0 |
| Distribution of assignments by functions | | |
| R&D or Engineering | 37 | 17 |
| Other | 11 | 1 |

TABLE III. NONEXEMPT EMPLOYMENT

| Nonexempt Employment Status | July | Aug. | Nonexempt Transfer Requests | July | Aug. |
|---|---|---|---|---|---|
| Requisitions | | | Transfer Requests | | |
| At end of month | 10* | 23 | Active cases at end of mo. | 55 | 54 |
| Cancelled | 1 | 0 | Cancelled | 1 | 6 |
| Received during month | 9 | 25 | New during month | 5 | 7 |
| Filled during month | 10 | 12 | Transfers effected | 2 | 2 |

* Correction: July report corrected from 8 to 10.

TABLE IV. UNION RELATIONS

Grievances Processed - January 1, 1958 to date

| | | |
|---|---|---|
| Total processed | 24 | (includes 3 non-unit grievances) |
| Step I | | |
| Answered satisfactorily* | 14 | |
| Step II | | |
| Pending Step II discussion | 2 | |
| Answered | | |
| Satisfactorily** | 7 | |
| Pending time limit | 1 | |
| Applied for arbitration | 1 | |

* Step I grievances which Council indicated a desire to discuss at Step II not scheduled for discussion within three months are considered settled at Step I.

** Step II grievances in which the Council formally applied for arbitration but for which no further action is taken within three months are considered settled at Step II.

# FINANCIAL OPERATION MONTHLY REPORT

## Personnel

There were no changes in Financial Operation personnel during August.

## Activities

### General Accounting Operation

A number of Approval Letters covering memberships on standards committees were submitted to the Commission. Two of these were recalled for more specific data on costs and a statement concerning the qualifications of the nominee. Another letter covering the University of Washington's proton research work has been delayed because of legal questions concerning the contract reference shown in the letter.

Hanford Laboratories will receive a General Plant Allocation in the near future, however this allocation will merely be an indication of our prorata portion of total funds available and will not be restrictive unless total General Plant Funds as allocated are used early in the fiscal year.

The running analysis of estimating accuracy on appropriation requests is shown below:

| | No. of AR's | Authorized Funds | Actual Cost | (Over) Under-run |
|---|---|---|---|---|
| Over-Run | | | | |
| By more than 10% Supplement Required | 26 | $117,888 | $160,540 | $(42,652) |
| By less than 10% | 27 | 171,464 | 178,702 | (7,238) |
| Under-Run | | | | |
| By more than 10% | 37 | 208,485 | 132,218 | 76,267 |
| By less than 10% | 30 | 218,604 | 213,604 | 5,414 |

Preparations were completed and a procedure distributed for the physical inventory of uninstalled cataloged equipment in the custody of Laboratory Auxiliaries Operation. The inventory will begin September 2, 1958 with an anticipated completion date of September 15, 1958 for all field work.

In preparation for the transfer of the 231-Z Building to HLO, a meeting was held with CPD and HLO Financial and landlord personnel in attendance. It was agreed that (1) a joint physical inventory would be taken, with HLO and CPD personnel participating, prior to the physical transfer, (2) any missing equipment will be written off the books by CPD, (3) Property Disposal Requests will be prepared by CPD, prior to transfer, for equipment in Cells #2, #3, #4 and #6 B-C in connection with project CHG-803 - Alterations - Building 231-Z, (4) the building and installed equipment will be transferred to HLO 100% depreciated. The physical inventory began August 20, 1958 and all field work was completed August 29, 1958. Items determined excess to the needs of HLO were marked and will be excessed or PDR'd prior to the physical transfer by CPD, however, the cost of removing the equipment and transporting to excess yards will be borne by HLO. The target date for transfer of the 231-Z Building and equipment is tentatively October 1, 1958.

A review of our composite depreciation rate and of our reserve accounts is in progress. Work on this review has been held up awaiting the receipt of an IBM listing with the required information. Adjustment will be made if required, and new composite depreciation rates placed in effect, retroactive to July 1, 1958.

As a result of recommendations developed jointly with Laboratory Auxiliaries and submitted to the Manager - Hanford Laboratories Operation, a central storage for HLO has been designated within the 300 Area. This warehouse location, the messanine in the 325 Building basement, will serve the 300 Area and outer areas as a central warehouse until such time as one of the PRTR warehouses is made available. The central warehouse will be used for the storage of equipment and materials which are currently not in use and for which there is a foreseeable need. The Financial Operation will assume responsibility for the storage area and for maintaining proper control. Benefits to be obtained from a central warehouse are more efficient utilization of equipment, dollar saving by preventing purchase of like items in storage, time saving in taking physical inventories, and space currently being used for storage will be available for other use.

All HEW identification tags affixed to Washington Designated Program equipment were removed during the month and new POO (property of others) identification tags applied. All tags covering RDX equipment located in the 300 Area have been painted red to clearly distinguish RDX equipment from capitalized movable equipment. This will enable field personnel to readily identify an item as either RDX or capital. A total of 77 new HEW tags were affixed to equipment received during the month.

Cost Accounting

An Interim Control Budget for FY 1959 has been established for HLO Level 3 components and Level 4 components with the exception of Reactor and Fuels R&D. Reactor and Fuels R&D Level 4 control budgets will be completed in time for inclusion on August reports. The control budget deviates from the Preliminary Financial Plan for programs that are anticipated to be adjusted in the firm plan which is expected in the next few weeks.

Specific authorizations received by Hanford Laboratories during August are as follows:

(1) $93,000 from IPD for NPR for the first four months of FY 1959.

(2) $75,000 from CPD for the Plutonium Metallurgy Operation on the 3000 Weapons Program. It is expected more funds will be forthcoming if additional funds are provided in the next Financial Plan.

(3) A purchase order for $210,000 from the US Air Force to cover atmospheric diffusion studies to be undertaken by the Atomospheric Physics Operation. Of this amount, it is planned that $50,000 will be operating costs with the balance to be used for equipment.

(4) A purchase order for $30,000 from ANP to cover thermal cycling studies to be performed by the Termal Hydraulics Operation.

Effective with the August cost reports, HLO Cost Accounting will not force "rounded" figures to add to the total amounts on the various report summaries which state amounts in thousands of dollars. It is expected that the elimination of this forced addition will save several hours a month during the period of report issuance.

An exploratory meeting was held with IBM representatives to discuss the feasibility of placing the HLO cost accounting system on an integrated data processing system. Conversion to IBM would be contingent upon the ability of Data Processing to economically perform the job, issue reports of at least the same quality as the present reports within as short or shorter time than our present manual system, and to permit increased cost analysis for HLO management.

Personnel Accounting

Significant meetings and conferences held in August are discussed below:

Personnel Records - Two meetings were held to disucss conversion of Personnel Records held by Employee Relations to the control and custody of Personnel Accounting Operation. Definite progress can be reported. Mutual agreement was obtained in most areas with specific questions on unsettled issues tabled for further investigation and discussion in later meetings. A complete, detailed report is expected in September.

GE - HAMTC Agreement - Cumulative efforts by the Managers - Personnel Accounting disclosed payroll problem areas in connection with the GE - HAMTC agreement. During the August meeting these difficulties were summarized in a letter to Managers - Union Relations. A total of 18 items were listed as representing problem areas.

Unique situations occurring in cases of Tech Grads in the Western Circuit Rotational Program and temporary summer employees who claim out-of-state legal residence will increase the number of states for which tax reporting is required. For the 3rd quarter, 1958 we will be withholding state income tax for Oregon, Idaho, Montana and Arizona.

Auditing

Reports were issued on Internal and Traveling Auditor coverage of all remaining audit areas scheduled for the audit year ended July 31, 1958.

The audit of Materials Furnished AEC Contractors is in progress. A review of R&UO - Project Budgets' records determined that fifty-four Project Proposals, Informal Requests and etc. are applicable to HLO activities since reorganization. Many of these have proven to be of no particular interest to the current investigation.

Drafting of the Traveling Auditor memorandum follow-up report requested by W. E. Johnson has been completed.

Measurements

Sample reports concerning the employee attitude indicators were finished for review by management. A unit cost index for Bioassay has been accepted by management and procedures for its routine reporting have been turned over to Cost Accounting.

Procedures

All form masters with prefix of "B" (signifies Printing Operation) applicable to HLO will be transferred from custody of R&UO Forms Control to custody of HLO Forms Control. This move has no effect on procedures or basic responsibilities. The change will result in approximately 250 masters located in 300 Area rather than 700

Area. By comparison, masters with prefix "A" (Duplicating Operation), which are also in HLO Forms Control, also number approximately 250.

During the month seven suggestions were evaluated with only one adoption. The adoption concerned use of thermofax paper and will appear as a suggestion in the next Management Newsletter. Five suggestions are still under consideration. All of these suggestions have pertained to stationery, forms, secretarial supplies, and other general office procedures matters.

## Payroll Statistics

| Number of HLO Employee Changes During Month | Total | Exempt | Non-Exempt |
|---|---|---|---|
| Employees on Payroll at Beginning of Month | 1 238 | 596 | 642 |
| Additions and Transfers In | 22 | 7 | 15 |
| Removals and Transfers Out | (28) | (19) | (9) |
| Employees on Payroll at End of Month | 1 232 | 584 | 648 |

| Overtime Payments During Month | August | July |
|---|---|---|
| Exempt | $ 7 600 | $ 5 408 |
| Non-Exempt | 6 848 | 12 564 |
| | $14 448 | $17 972 |

| Gross Payroll Paid During Month | | |
|---|---|---|
| Exempt | $463 984 | $458 362 |
| Non-Exempt | 342 365 | 279 028 |
| | $806 349 | $737 390 |

| Participation in Employee Benefit Plans at Month End | No. Participating August | No. Participating July | % Participating August | % Participating July |
|---|---|---|---|---|
| Pension Plan | 1 186 | 1 190 | 98.7 | 98.7 |
| Insurance Plan | | | | |
| Personal Coverage | 1 248 | 1 247 | 99.8 | 99.8 |
| Dependent Coverage | 799 | 797 | - | - |
| U.S. Savings Bonds | | | | |
| Stock Bonus Plan | 755 | 751 | 61.9 | 60.6 |
| Savings Plan | 86 | 87 | 7.0 | 7.0 |

| Insurance Claims | August Number | August Amount | July Number | July Amount |
|---|---|---|---|---|
| Employee Benefits | | | | |
| Life Insurance | 1 | $18 700 | -0- | $ -0- |
| Weekly Sickness & Accident | 10 | 718 | 15 | 1 300 |
| Comprehensive Medical | 21 | 1 525 | 30 | 5 111 |
| Dependent Benefits | | | | |
| Comprehensive Medical | 57 | 5 558 | 63 | 6 881 |
| Total | 89 | $26 501 | 108 | $13 292 |

| Good Neighbor Fund | August | July |
|---|---|---|
| Number participating | 789 | 785 |
| Percent participating | 64.0 | 63.4 |

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## INVENTIONS OR DISCOVERIES

All persons engaged in work that might reasonably be expected to result in inventions or discoveries advise that, to the best of their knowledge and belief no inventions or discoveries were made in the course of their work during the period covered by this report except as listed below. Such persons further advise that, for the period therein covered by this report, notebook records, if any, kept in the course of their work have been examined for possible inventions or discoveries.

| INVENTOR | TITLE OF INVENTION OR DISCOVERY |
|---|---|
| H. V. Larson<br>I. T. Myers | High Precision Condenser Voltmeter |
| R. A. Harvey<br>D. A. Campbell | A Stack Effluent Radioisotope Monitor |
| H. H. Van Tuyl | The Metathesis of Cesium Ferrocyanides, Ferricyanides, and Cobalticyanides with Silver Carbonate, HW-57228 |
| L. L. Burger | Use of Talc for Solvent Treatment in Solvent Extraction Processes |
| F. P. Roberts<br>J. L. Ryan | Separation of Neptunium and Plutonium by Anion Exchange Using Ferrous Sulfamate and Semicarbazide |
| R. H. Moore<br>W. L. Lyon | A Pyrochemical Method for Separation of Uranium and Thorium, HW-57158 |
| W. L. Lyon<br>R. H. Moore | The Reduction of Plutonium Chloride by Magnesium, HW-57334 |
| V. H. Troutner | An Optimum Organic Coolant Mixture for Use as a Nuclear Reactor Coolant, Moderator, or Shield |
| V. H. Troutner | A Four-Component Optimum Organic Coolant Mixture for Use as a Nuclear Reactor Coolant, Moderator, or Shield |

H. M. Parker